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NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical Chemistry

Refer also to abstracts 25328 and 25950.

24991 CHEMICAL ANALYSIS OF MOON SAMPLES. **Reese, K. M. Anal. Chem.; 42: 26A-33; 36A-8(May 1970).**

A review is presented on the detailed preparations that went into and results of the many analytical studies on Apollo 11 lunar samples. The review is based on results reported at the Lunar Science Conference held Jan. 5 to 8, 1970 at Houston, Texas. Elemental abundances of lunar samples compared with those of the earth's crust are tabulated. (J.G.B.)

Chemical and Spectral Procedures

Refer also to abstracts 25352, 25434, 25665, and 25669.

24992 (AERE-R-6247) SOME METHODS OF ELIMINATING MATRIX EFFECTS DUE TO A SINGLE INTERFERING ELEMENT IN RADIOISOTOPE X-RAY FLUORESCENCE SPECTROMETRY. Dziunikowski, B. (United Kingdom Atomic Energy Authority, Wantage (England). Research Group). Jan 1970. 18p. Dep. CFSTI (U. S. Sales Only). UK 3s. 0d.

Three methods of overcoming matrix effects in radioisotope x-ray fluorescence are suggested based on measurements with one, two, or three elemental filters. Examples illustrating the measurement of the concentration of copper in copper ores when iron is present as the interfering element are given, but the methods can also be extended to any other material in which there is only one interfering element. Application of the suggested methods can considerably improve the accuracy of certain measurements and the choice of the method depends on the particular problem, especially on the range of concentration of the wanted and interfering elements. (auth) (UK)

24993 DISTRIBUTION OF 70-kV PRASEODYMIUM IONS IN IRON FOIL AND A TECHNIQUE FOR REMOVING THIN LAYERS OF IRON. Laudgrebe, A. R.; Mann, W. B.; Schima, F. J. (National Bureau of Standards, Washington, D. C.). Int. J. Appl. Radiat. Isotop.; 21: 169-71(Mar 1970).

A new chemical stripping technique was used for the measurement of the distribution of Pr ions implanted in iron foils. This sectioning technique is based on the use of a chelating buffer system as stripping agent. Advantages of this technique over other chemical procedures are stated to be constant pH for any particular buffer medium, and near zero concentration of the cation since it is complexed almost instantaneously; also the very small concentration of stripping reagent (H-ion concentration of 10^{-2} to 10^{-7} $\underline{M}$, depending on the buffer) allows removal of very small amounts of foil at a time. The following weak acids were investigated as stripping agents: EDTA, chloracetic acid in sodium acetate buffer, and various concentrations of citric acid. Experiments were made to determine the resolution of Pr as a function of mass, and to determine the penetration profile of the implanted Pr ions. In these experiments an accelerating potential of 70 kV was employed. Graphs are given for the dispersion of ^{142}Pr ions in stepped Fe foils and for the penetration profiles of ^{141}Pr and ^{142}Pr. Substantial penetration of Pr into the foil was indicated. It was also found that the median range for ^{141}Pr was several times that for ^{142}Pr. A possible explanation for this is that the difference may have been due to thermal diffusion of the ^{141}Pr during reactor activation. (UK)

24994 DIRECT READING EMISSION SPECTROMETRIC DETERMINATION OF TRACE ELEMENTS IN RARE EARTH COMPOUNDS INCORPORATING A ROTATING ELECTRODE. EFFECTS OF ALKALI CHLORIDES AS RADIATION BUFFERS. Osumi, Yasuaki; Kato, Akihiko; Miyake, Yoshizo (Government Industrial Research Inst., Osaka). Anal. Chem.; 42: 664-7(May 1970).

Solution excitation methods were investigated for the determination of trace amounts of elements in rare earth compounds. Sensitivity was found to be enhanced by the addition of alkali salts as radiation buffers, cesium chloride being the most effective. The rotating electrode method and photoelectric measurement were used. Data are presented on the detection of Ce, Eu, Gd, Nd, Pr, Sm, and Y in lanthanum and yttrium oxides. (J.G.B.)

24995 SPARK SOURCE MASS SPECTROGRAPHIC ANALYSIS OF INGOT IRON FOR SILVER, COPPER, MOLYBDENUM, AND NICKEL BY ISOTOPE DILUTION AND FOR COBALT BY AN INTERNAL STANDARD TECHNIQUE. Paulsen, Paul J.; Alvarez, Robert; Mueller, Charles W. (National Bureau of Standards, Washington, D. C.). Anal. Chem.; 42: 673-5(May 1970).

An isotope dilution spark source mass spectrometry (ID-SSMS) method was developed for simultaneously determining trace amounts of silver and other elements in ingot iron. Silver, copper, molybdenum, nickel, and cobalt were satisfactorily electrodeposited onto gold wire electrodes after extracting the iron from a solution of ingot iron, NBS-SRM 1165. The aqueous layer had been neutralized before electrolysis. By spiking the sample solution with known amounts of enriched isotope solutions, the elements Ag, Cu, Mo, and Ni could be determined. Co was also determinable because of its chemical and electrochemical similarity to Ni. (auth)

24996 DETERMINATION OF TRACE QUANTITIES OF TELLURIUM IN BISMUTH BY ATOMIC-ABSORPTION SPECTROPHOTOMETRY. Roth, D. J.; Bohl, D. R.; Sellers, D. E. (Monsanto Research Corp., Miamisburg, Ohio). At. Absorption Newslett.; 7: No. 5, 87-9(1968).

The previously published method for the extraction of Te into isobutyl methyl ketone from a solution of Bi in $6\underline{N}$ HCl was modified for the range of 0 to 30 ppM of Te. For a Te content of >1 ppM, a 1-g sample, a 1-g sample plus 1 ml of a Te solution (10 μg/ml), and a 1-g sample plus 2 ml of the Te solution are dissolved in concentrated HCl (20 ml) and concentrated HNO_3 (2 ml) by warming. Twenty to 30 ml of concentrated HCl are added to each solution, the solutions evaporated to dryness, the residues dissolved in 10 ml concentrated HCl, and 10 ml of H_2O added. For a Te content <1 ppM, 10-g samples are treated similarly using 10 ml of concentrated HNO_3. Each solution is extracted with 10 ml of isobutyl methyl ketone by shaking vigorously for 40 sec. The organic layer is washed with two 20-ml portions of HCl, dried over anhydrous Na_2SO_4, and aspirated into an air-acetylene flame. The absorbance at 214 nm is plotted vs the concentration of added Te to obtain the Te content in the sample by extrapolation. Alternatively, the standard Te solution is added to a solution of 99.99% pure Bi and a calibration graph is prepared that is rectilinear up to 100 μg of Te. The precision at the 1-ppM level is ±0.1 ppM. The efficiency of the extraction was shown to be 98 to 99% and the limit of detection 0.01 ppM by square-wave polarography. (Anal. Abstr.)

24997 DETERMINATION OF TELLURIUM BY ATOMIC-ABSORPTION SPECTROPHOTOMETRY. Wu, J. Y. L.; Droll,

H. A.; Lott, P. F. (Univ. of Missouri, Kansas City). At. Absorption Newslett.; 7: No. 5, 90-3(1968).

Investigations of the extraction of Te as a complex with Na diethyl dithiocarbamate, bismuthiol II, or ammonium tetramethylenedithiocarbamate (I) by 4 ketonic solvents are described. The use of I at pH 4 to 6 and acetylacetone as solvent gave the highest extraction (99.5%). Five ml of a 1 M solution of NH_4Cl and 1 ml of a 0.6% solution of I in 80% aqueous ethanol are added to a 5-ml portion of a standard Te solution containing 5 to 25 μg Te/ml, the pH is adjusted to 4 to 6, 9 ml of water and 1 g of NaCl are added, and the chelates are extracted with 20 ml of acetylacetone by shaking for 5 min. The organic layers are aspirated into an air–acetylene flame, and a calibration graph is prepared at 2143 Å. For samples containing 25 μg Te/ml and one of 50 listed ions (50 μg/ml) Te recovered was 24.7 to 25.9 μg/ml. Interference by Cu(II), Sb(III), Se(IV), and Hg(II) is minimized by masking with EDTA prior to extraction. The tolerance to foreign ions is 4-fold that of the spectrophotometric methods. The standard deviation for the determination of 25 μg of Te/ml is 0.64 μg/ml (16 determinations). (Anal. Abstr.)

24998 EXTRACTION–PHOTOMETRIC DETERMINATION OF SILICON IN NIOBIUM AND TANTALUM. Kurbatova, V. I.; Kalashnikova, L. Ya. Tr. Vses. Nauch.-Issled. Inst. Stand. Obraztsov Spektr.; 4: 174-80(1968). (In Russian).

For determination of ≈10 ppM of Si, a 0.3- to 0.5-g sample is fused in a Pt crucible at 1000°C with 4 g of Na_2CO_3. The melt is extracted with water into a beaker and heated for 1 hr. The precipitate and solution are diluted to 100 ml and filtered through a dry filter. The pH of 50 ml of the filtrate is adjusted to 1.5, 5 ml of a 5% solution of ammonium molybdate(I) is added, and the solution is allowed to stand for 10 min. Then 10 ml of a 20% tartaric acid solution, 12.5 ml of HNO_3 (1 : 2) and 10 ml of butanol are added. The mixture is shaken, and the extraction is repeated. The organic phases are washed with H_2SO_4 solution containing a small amount of I. Then 0.2 g of $(NH_4)_2SO_4 \cdot FeSO_4 \cdot 6H_2O$, 0.25 ml of H_2SO_4 (1 : 6), and 5 g of ascorbic acid dissolved in 100 ml of H_2O are added to the extract, and the mixture is shaken for 30 sec. After 5 min, the extract is filtered, diluted to 30 ml with butanol, and the extinction (red filter) is measured against the extract of a blank solution. Beer's law is obeyed with 0.1 to 1 μg Si/ml. (Referativnyi Zh.)

24999 IMPROVEMENTS IN OR RELATING TO THE ANALYSIS OF MATERIALS. Clayton, Colin Geoffrey; Dziunikowski, Wladyslaw (to United Kingdom Atomic Energy Authority). British Patent 1,183,514. 11 Mar 1970. Filed 28 Apr 1967.

Improvements to the technique of x-ray fluorescence analysis are described. Natural or artificial radioisotope sources are employed to excite fluorescence. If the material contains an "interfering element", that is, an element having an atomic number close to, but less than, the atomic number of the wanted element, difficulties are caused by the characteristic radiation emitted by the wanted element being to some extent absorbed by the interfering element and re-emitted as the characteristic radiation of the interfering element ("matrix effect"). The method involves separate determination of the following; (a) the intensity I_w of the fluorescent radiation at the characteristic fluorescent energy of the wanted element; (b) the intensity I_i of the fluorescent radiation at the characteristic fluorescent energy of the interfering element; (c) the intensity I_b of the backscattered radiation over an energy band that is intermediate between, but does not contain, the characteristic fluorescent energies of the wanted and interfering elements. The quantity of the wanted element is then determined from a calibration nomogram obtained by plotting I_i/I_b against I_w/I_b. Balanced filters may be used for each determination. Where a second major interfering element is present a three-dimensional nomogram is used. (UK)

25000 SPECTROPHOTOMETRIC DETERMINATION OF RHENIUM IN ALLOYS WITH THIOSALICYLIC ACID. Talipova, L. L.; Abramova, E. L.; Gurevich, E. A.; Parpiev, N. A. (Inst. Chemistry, Tashkent). Uzb. Khim. Zh.; No. 4, 13-16(1969). (In Russian).

A spectrophotometric method was developed for the determination of rhenium that does not require its separation from other elements. Large amounts of Ca, Mg, Mn, Ce, Zn, Al, Ge, In, Ti, UO_2^{2+}, and others do not affect the reactions for separation. The effect of Fe^{3+} is eliminated by the addition of ascorbic acid. The relative error in the determination is ±3 to 4%. (tr-auth)

25001 ELECTRON MICROPROBE ANALYSIS OF IRRADIATED FUELS. Johnson, C. E.; Crouthamel, C. E.; Chen, H.; Blackburn, P. (Argonne National Lab., Ill.). pp 139–44 of Proceedings of Second Annual Technical Meeting, International Metallographic Society, Inc., September 8–10, 1969, San Francisco, California. /Bender, J. H. (ed.). Los Alamos, N. Mex.; International Metallographic Society, Inc. (1970).

See CONF-690920.

Electron microprobe analysis was used to elucidate chemical behavior in irradiated fuels. The experimental approach emphasized detailed investigations of complete fuel pin cross sections and correlation of the analysis with its complete physicochemical history. The significance of the elements found, such as Pu, U, Al, Ba, Cs, Fe, Te, Ni, Cr, and I, in the areas of intergranular attack, fuel-cladding interface, a gray phase in the fuel matrix, and the PuO_2-UO_2 fuel itself are discussed. (P.C.H.)

25002 ULTRAMICRO METHODS OF CHROMATOGRAPHIC ANALYSIS OF NUCLEOSIDES AND OF OLIGONUCLEOTIDES AFTER LABELING BY TRITIATED BORON HYDRIDE. Desreumaux, S.; Barbry, G.; Segard, E. (Faculte des Sciences, Lille). pp 296–304 of Chromatographie Electrophorese. Bruxelles; Presses Academiques Europeennes (1969). (In French).

From 5th International Symposium on Chromatography and Electrophoresis, Brussels, Belgium. See CONF-680971.

Activity sites of nucleosides and oligonucleotides were studied after labeling by means of tritiated sodium borohydride. The compounds were marked externally, separated, and analyzed by electrophoresis and paper chromatography. (J.G.B.)

25003 SPECTROPHOTOMETRIC DETERMINATION OF HEAVY WATER IN H_2O/D_2O MIXTURES IN THE NEAR INFRARED. Keil, R. (Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen, Switzerland). Z. Anal. Chem.; 249: 289-92(19 Mar 1970). (In German).

Three different methods are described for the determination of D_2O in D_2O-H_2O mixtures by means of IR absorption. Wavelengths, concentration ranges and accuracies are as follows: 2500 nm: 99 to 100 mole % D_2O, ± 0.001%; 1670 nm: 0 to 20 mole % D_2O, ± 0.02%; 1368 nm: 0 to 100% D_2O, ± 0.1%. The methods are simple, rapid and have been successfully used for several years. (auth)

25004 VOLUMETRIC ANALYSIS AND CATALYSIS. V. CHELATOMETRIC TITRATIONS WITH THERMOMETRIC END-POINT INDICATION. Weisz, H.; Kiss, T. (Univ., Freiburg i. B.). Z. Anal. Chem.; 249: 302-3(19 Mar 1970). (In German).

The direct titration of EDTA and DCTA as well as the determination of a number of metal ions (Zn^{2+}, Cd^{2+}, Cu^{2+}, Ni^{2+}, Mn^{2+}, Pb^{2+}, Hg^{2+}, Sn^{2+}, Al^{3+}, In^{3+}, Ga^{3+}, Th^{4+}) by back titration with manganese(II) standard solution is described. The decomposition of hydrogen peroxide and the reaction between hydrogen peroxide and resorcinol, both catalysed by manganese, were used as indicator systems. (auth)

25005 VOLUMETRIC ANALYSIS AND CATALYSIS. VI. CHELATOMETRIC DETERMINATIONS BY SUBSTITUTION TITRATION. Klockow, D.; Beltran, L. Garcia (Univ., Freiburg i. B.). Z. Anal. Chem.; 249: 304-7(19 Mar 1970). (In German).

A modification of the titration with catalytic end-point detection is described. The sample solution contains the reactants of the catalyzed indicator reaction as well as the catalyst in a blocked inactive form. At the end-point, the first drop in excess of the titrant causes the release of the catalyst and consequently the start of the indicator reaction. This substitution method was used for various chelatometric titrations. The determination of the alkaline earth metals and of water hardness is possible. The Mn-catalysed reaction between H_2O_2 and resorcinol is employed as indicator system. (auth)

Isotopic Procedures

25006 ANALYSIS OF RARE EARTHS IN GEOLOGICAL SAMPLES BY ISOTOPIC DILUTION AND MASS SPECTROMETRY. APPLICATION TO THE DISTINCTION BETWEEN CARBONATITES AND LIMESTONES. Loubet, Michel (Paris Univ.); Allegre, Claude J. Compt. Rend., Ser. D.; 270: 912-15(16 Feb 1970). (In French).

The method of isotopic dilution and mass spectrometry of rare earths has the advantage of being sensitive, very accurate, and rapid. This led to the development of a technique by which rare earths may be determined to 10 ppB, with a precision of 1 to 5%. Measurements of rare earths in carbonatites are reported and inferences drawn from the results. (France)

Radiometric Procedures

Refer also to abstracts 25255, 25261, 25288, 25297, 25322, and 25355.

25007 (WCAP-6086) SUPPLEMENTARY REPORT ON EVALUATION OF MASS SPECTROMETRIC AND RADIOCHEMICAL

ANALYSES OF YANKEE CORE I SPENT FUEL, INCLUDING ISOTOPES OF ELEMENTS THORIUM THROUGH CURIUM. Nodvik, R. J. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). Aug 1969. Contract AT(30-1)-3017. 259p. Dep. CFSTI.

Results of mass and alpha spectrometric, x-ray spectrographic, and radiochemical analyses of spent fuel samples irradiated in Yankee—Rowe Cores I, II, and IV are presented. In addition to the analyses for the main chain uranium and plutonium isotopes, analyses for certain other isotopes of the actinide series were performed, including Th-232, Pa-231, U-232, and U-233 in irradiated fuel samples, and U-232, U-233, Np-237, Pu-236, Pu-238, Am-241, Am-243, Cm-242, and Cm-244 in irradiated fuel samples. A significant aspect of this study is the comparison of the measured isotopic data with results obtained with a matrix exponential calculational method incorporated in the LASER-HIC Computer program. This method uses the ENDF/B cross section data for those isotopes for which such data are available, and calculated cross sections for those isotopes for which such data have not been established. These comparisons indicate the validity of the theoretical model and the relative accuracy of the basic nuclear data documented within this report. Several methods for the determination of fuel burnup are applied to measured data and evaluated. As an example, the value of burnup inferred from Nd-148 concentration is compared with corresponding values of burnup inferred from Cs-137 and Sr-90 activity, and the conservation of heavy element nuclei. (auth)

25008 IMPROVEMENTS IN RADIOMETRIC ANALYSIS. Starnes, Peter Edward (to Hilger and Watts Ltd.). British Patent 1,184,951. 18 Mar 1970. Filed 11 Sep 1963.

An improved apparatus for determining the chemical composition of materials by radiometric analysis is described. The sample must be in the form of a dry powder, which is submitted to an incident beam of x-rays, electrons, neutrons, or mixed radiation, the resultant radiation from the sample being characteristic of the individual elements of the sample material. An earlier patented apparatus included a movable sample carrier, means for forming a layer or ribbon of powdered sample material on the carrier, of continuously measured and substantially constant mass per unit area and substantially constant thickness and width. The improvements include the use of a vibratory conveyor mounted on a fulcrum balance as sample carrier, and the apparatus includes a weight transducer, which is responsive to the force transmitted by the balance beam, and is associated with an amplifier and an indicating/recording instrument to provide an indication of the mass of sample material on the conveyor at any time. A second vibratory conveyor may be provided to feed sample material on to the first conveyor, and means may be provided for controlling the rate of feed of the material on to the carrier in response to a signal derived from the transducer. A feed hopper may also be provided and may include a stirring paddle and an anti-flooding discharge device. The second conveyor may include a gate which operates to cause the material discharged on to the conveyor to form a layer or ribbon. The balance beam may be provided with an oil dashpot to avoid any tendency to oscillation, and may also be provided with a catenary chain and wheel assembly to give a fine weight adjustment. (UK)

25009 THE USE OF SILVER CHROMATE-^{51}Cr COLUMNS TO DETERMINE CHLORIDES AND SULPHIDES IN SOLUTION. Bowen, H. J. M. (Reading Univ., Eng.). Radiochem. Radioanal. Lett.; 3: 339-42(24 Apr 1970).

Micromoles (0.8 to 80) of chloride, or 0.4 to 40 micromoles of sulfate, in aqueous solution may be determined by passing the solution through a short column of silver chromate-^{51}Cr and counting the eluate. Anions giving very insoluble silver salts interfere e.g., bromide, iodide, cyanide, thiocyanate, and sulfite, and the technique is not suitable for solutions with pH < 4. (auth)

25010 RAPID DETERMINATION OF ^{13}N AND ^{18}F IN REACTOR COOLING WATER BY AN ION-EXCHANGE METHOD. Ohno, S. (National Inst. of Radiological Sciences, Chiba, Japan); Tsutsui, T. Analyst; 95: 396-8(Apr 1970).

Nitrogen-13 and fluorine-18 are formed mainly by the ^{16}O (p,α) ^{13}N and the ^{18}O (p,n) ^{18}F reactions, respectively, in reactor cooling water. Nitrogen-13 and fluorine-18 were determined in reactor cooling water from the Kyoto University reactor by an ion exchange method. The measured radioactivities of nitrogen-13 and fluorine-18 were 4.5 and 0.3 nCi ml^{-1}, respectively, at 5MW of reactor operating power. The sensitivity of this method is about 1 pCi ml^{-1} for fluorine-18 and 5 pCi ml^{-1} for nitrogen-13. The precision of this method is about ±5 per cent. (auth) (UK)

Activation Procedures

Refer also to abstract 25356.

25011 (CEA-R-3955) PROGRAM ELEMENTS FOR GAMMA SPECTROMETRY AND ACTIVATION ANALYSIS. Junod, Eric (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Feb 1970. 86p. (In French). Dep. CFSTI (U. S. Sales Only).

The basic sub-programs or complementary programs, with their FORTRAN lists, were established or adapted with a view to develop an important system for the processing of gamma spectra. The general organigram of this system (GASPARD) is given in an appendix as an example of the drawing-up of sub-programs. (FRANCE)

25012 (NBS-TN-519) FORENSIC SCIENCE: A BIBLIOGRAPHY OF ACTIVATION ANALYSIS PAPERS. Lutz, G. J. (ed.) (National Bureau of Standards, Washington, D. C.). Mar 1970. 47p. GPO $0.50.

References on activation analysis in forensic science are indexed into 32 categories for precise literature searching. An author index is included. (auth)

25013 SEPARATION AND DETERMINATION OF TRACES OF BROMINE IN POTABLE WATER BY ACTIVATION ANALYSIS. Leddicotte, G. W.; Navarrete Tejero, M. (Univ. of Missouri, Columbia). Rev. Soc. Quim. Mex.; 12: 223A-4A(1968). (In Spanish).

A sample of potable water is passed through a column of Amberlite IR-100, and a portion of the resin is activated for 1 min in a neutron flux of ~10^{14} n/cm^2-sec. The resin is extracted with a solution of NH_4Br in concentrated HCl. Ammonium bromide and concentrated aqueous $KMnO_4$ are added to the extract until the purple color persists, and a CCl_4 extract of the solution is then analyzed for ^{82}Br in a multi-channel analyzer with a NaI(Tl) crystal. The lower limit of detection is 0.1 ng of Br. (Anal. Abstr.)

25014 NEUTRON ACTIVATION ANALYSIS OF TRACE ELEMENTS IN SKIN. II. MANGANESE IN NORMAL SKIN. Molokhia, Mohamed; Portnoy, Benjamin (Manchester and Salford Hospital for Skin Diseases, Manchester, Eng.). Brit. J. Dermatol.; 81: 681-4(Sep 1969).

Manganese levels in normal epidermis and dermis from 34 cadavers were estimated by neutron activation analysis. The mean concentration of manganese in the epidermis was 4 times higher than that in the dermis. An important biological role for manganese in skin is suggested by the remarkably narrow range of concentration of that trace metal in the analyzed samples. (auth)

25015 STUDIES ON THE FINENESS OF SILVER COINS. Bacharach, Jere L.; Gordus, Adon A. J. Econ. Social Hist. Orient; 11: 298-317(1968). (COO-912-19).

A neutron activation method for determination of Ag in ancient coins was developed and applied to Muslim dirhams issued in Egypt and Syria in A. H. 648 to 922 (A.D. 1250 to 1517). Only Ag is activated and the radioactivity dissipates within 10 to 15 min. The method results in Ag contents valid to ~±2%. In order to avoid production of very long half-life ^{110m}Ag, a small neutron source was used for irradiation. The coin was mounted on a Ag disk to ensure more uniform thickness on irregular coins. The results of neutron activation analysis are compared with those from destructive analysis. (B.L.M.)

25016 QUANTITATIVE NON-DESTRUCTIVE NEUTRON ACTIVATION ANALYSIS OF SILVER IN COINS. Gordus, A. A. (Univ. of Michigan, Ann Arbor). Archaeometry; 10: 78-86(1967). (COO-912-11).

A rapid nondestructive neutron activation method is described for the determination of Ag in ancient coins. A Pu—Be source is used for the irradiation to obtain a low neutron flux to yield only the Ag isotopes ^{108}Ag and ^{110}Ag, which have short half-lives. In order to more nearly ensure uniform thickness of the coins, all old coins were taped to a silver disk or to an uncirculated U. S. 10¢ piece. The validity of the method was tested on a number of modern U.S. and European coins of known Ag content. The method was applied to various ancient coins, and the deviation of the Ag content was ~8%. (B.L.M.)

25017 POSSIBLE USE OF NEUTRON ACTIVATION ANALYSIS IN NONFERROUS METALLURGY IN THE URALS. Potashev, P. I.; Gavrilov, I. P. Tr., Ural. Nauch.-Issled. Proekt. Inst. Mednoi Prom.; No. 11, 327-33(1969). (In Russian).

Neutron activation analysis was proposed as a method for determination of trace elements in ores. By 1-hr irradiation in a neutron flux of 1.8 × 10^{12} n/cm^2-sec a sensitivity of <0.001%

can be attained for most elements. A table of comparison between neutron activation analysis and 8 other methods of instrumental analysis was given for 31 elements with the limit of detection in the order of 10^{-6} to 10^{-13} g. (Selenium-Tellurium Abstr.)

25018 DETERMINATION OF PHOSPHIDES AND WHITE PHOSPHORUS IN BIOLOGICAL MATERIALS BY NEUTRON ACTIVATION ANALYSIS. Krishnan, S. S.; Gupta, R. C. (Centre of Forensic Sciences, Toronto). Anal. Chem.; 42: 557-60(May 1970).

A method for the determination of nanogram amounts of toxic phosphorus, i.e., phosphides and white phosphorus, in biological materials was developed. The technique consists of distillation of phosphorus as phosphine and collection of the phosphine as silver phosphide by reaction with silver nitrate. The silver phosphide is then oxidized to silver phosphate by chlorine and the amount of phosphorus is determined by thermal neutron activation analysis. A radiochemical separation procedure involving ion-exchange and precipitation methods is used for the separation of phosphorus-32 activity induced during the neutron activation. The technique can be adapted to differentiate phosphine which is produced as a product of putrefaction in tissues, metal phosphides, and white phosphorus. The method is capable of uniquely identifying phosphorus and is sensitive down to 10 ng of phosphorus. It enables quantitative analysis of phosphorus at nanogram levels with an accuracy of ±10%. This constitutes an important advance for applications in the medico-legal field. (auth)

25019 SOME FEATURES OF CHLORINE AND BROMINE IN AEROSOLS. Louks, Ronald H.; Winchester, John W. (Univ. of Michigan, Ann Arbor). J. Geophys. Res.; 75: 2311-15(20 Apr 1970).

Size fractions of inland aerosols collected by cascade impactor were analyzed for Cl and Br by neutron activation. Br mass often shows an approximately inverse radius dependence with impactor size range, corresponding to a distribution proportional to total surface area of particles in each size range. A decrease in abundance observed in the intermediate-sized fractions, as compared with smaller particles, during precipitation is interpreted as reflecting the lower size limit for particles nucleating cloud droplets or crystals. The low ratio of Br to Cl found in larger particles and precipitation, as compared with smaller particles, suggests that Cl-rich particles are activated and removed from the atmosphere by precipitation more efficiently than Br-rich particles. (auth)

25020 NEUTRON ACTIVATION ANALYSIS OF IODINE TRACES IN ACTIVATED CHARCOAL FILTERS. Palomares, J.; Travesi, A.; Dominguez, G. (Junta de Energia Nuclear, Madrid). Radiochem. Radioanal. Lett.; 3: 357-64(24 Apr 1970).

A neutron activation analysis method for iodine in active charcoal has been developed in connection with a programme for evaluating the atmospheric dispersion of accidentally released fission products. ^{128}I (T = 25 min) produced by neutron activation in the charcoal samples, is isolated by a fast radiochemical procedure involving distillation in concentrated sulfuric acid solution and solvent extraction using isotopic iodine carrier. Activity and yield determinations are carried out directly on the final organic solution, by γ-radiation measurement and spectrophotometric absorption of the carrier, respectively. The method has been tested in the range from 0.5 to 20.0 ppM with active charcoal samples of known iodine content, prepared by absorption of known specific activity ^{131}I in charcoal traps. A precision better than 6% is obtained in the whole range. The method is able to determine as little as 10^{-6} g of iodine under the given experimental conditions. (auth)

25021 DETERMINATION OF TRACE IMPURITIES IN GERMANIUM BY MEANS OF ACTIVATION ANALYSIS. Simkova, M.; Kukula, F. (Nuclear Research Inst., Rez, Czech.). Radiochem. Radioanal. Lett.; 3: 295-303(24 Apr 1970).

Gold, copper, and nickel were determined in germanium used for the production of semiconductors. Nickel was separated by precipitation with dimethylglyoxime. Gold and copper were determined successively substoichiometrically with zinc diethyldithiocarbamate; gold in the media of 1N HCl, copper in alkaline media in the presence of EDTA and citric acid. (auth)

25022 TIME DEPENDENT CHARGED PARTICLE ACTIVATION ANALYSIS: AN APPROACH FOR STUDYING TRACE ELEMENT DISTRIBUTIONS. Rook, H. L.; Schweikert, E. A. (Texas A and M Univ., College Station). Radiochem. Radioanal. Lett.; 3: 239-48(24 Apr 1970).

The possibility of determining trace impurity distribution using time-dependent variable energy charged-particle activation analysis is discussed and the experimental apparatus used is described. Results for theoretical and experimental model studies of varying carbon impurity concentrations in aluminum are given, together with a discussion on the current limitations of this method. (auth)

25023 DETERMINATION OF RHENIUM AND OTHER TRACE ELEMENTS IN MOLYBDENITES BY MEANS OF INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS. Randa, Z.; Benada, J.; Kuncir, J.; Vobecky, M. (Nuclear Research Inst., Rez, Czech.). Radiochem. Radioanal. Lett.; 3: 227-37(24 Apr 1970).

The 155.1-keV peak of ^{188}Re was used for the determination of rhenium in molybdenites by instrumental activation analysis using a lithium-drifted germanium detector. The estimated minimum detectable limit was 1.5 ppM Re. The following trace elements were also estimated in molybdenites by the nondestructive method: tungsten (detectability limit 15 ppM), selenium, scandium, thorium, silver, tantalum, chromium, hafnium, and cesium. (auth)

25024 THE DETERMINATION OF PROTEIN-BOUND IODINE BY NEUTRON ACTIVATION ANALYSIS. Veselsky, J. C.; Nedbalek, M.; Suschny, O. (International Atomic Energy Agency, Seibersdorf, Austria). Int. J. Appl. Radiat. Isotop.; 21: 225-36(Apr 1970).

Conventional methods of PBI (protein bound iodine) determination are reviewed and a method for its determination by activation analysis described. PBI is separated from inorganic iodine in plasma samples by gel filtration in a phosphate buffer medium. It is then determined by an activation analytical procedure including chemical separation of ^{128}I, simple measurement of this isotope in an ordinary liquid beta-counting tube followed by a determination of the chemical recovery making use of an iodometric procedure. Commercial standards analysed by this method showed a PBI value that was consistently higher (by about 20%) than the corresponding values obtained by a purely chemical method. Analyses carried out on rat plasma did not show such a difference. The effect is believed to be due to the composition of the standards used. (auth) (UK)

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Refer also to abstracts 25069, 25076, 25077, 25079, 25633, and 26631.

25025 (ORNL-TM-2916) REVIEW OF THE ADSORPTION OF IODINE ON METAL AND ITS BEHAVIOR IN LOOPS. Hoinkis, E. (Oak Ridge National Lab., Tenn.). May 1970. Contract W-7405-eng-26. 68p. Dep. CFSTI.

The partial pressures of the iron iodides at equilibrium with solid FeI_2 in the system Fe–I were calculated for the regions where the solid phases are Fe(s) and Fe(s) + FeI_2(s) as function of temperature and pressure. The investigations of iodine adsorption on metal surfaces and of iodine deposition in loops was reviewed. The methods used and the results of the experiments are discussed with respect to the behavior of iodine in coolant circuits of helium-cooled, graphite-moderated reactors. (auth)

25026 (RFP-Trans-63) INFRARED ABSORPTION SPECTRA OF COMPLEX FORMATES OF THORIUM. Evstaf'eva, O. N.; Ivanova, O. M.; Molodkin, A. K.; Dvoryaptseva, G. A.; Struchkova, M. T. Translated from Dokl. Akad. Nauk SSSR; 172: 860-2 (1967). 6p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 21: 35929.

25027 (UCRL-Trans-10457) IN VACUO REACTION OF URANIUM DIOXIDE WITH CARBON. Vlasov, V. G.; Revebtsov, V. V. Translated for Univ. of California, Lawrence Radiation Lab., Livermore, from Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 3, 105-9(1969). 9p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 24: 11538.

25028 CHEMICAL FRACTIONATIONS IN METEORITES. III. MAJOR ELEMENT FRACTIONATIONS IN CHONDRITES. Larimer, J. W.; Anders, Edward (Univ. of Chicago). Geochim. Cosmochim. Acta; 34: 367-87(Mar 1970).

Some 20 elements, including the major constituents of chondritic matter, are fractionated among the several chondrite classes. An attempt was made to explain these fractionations on the assumption that they occurred in the solar nebula, starting from material of carbonaceous chondrite composition. The lithophile elements (Al, Ca, Cr, Hf, Mg, Sc, Si, Th, Ti, U, Y, Zr, and lanthanides) may have been fractionated at 1300 to 1350°K by partial loss of an early condensate, consisting of minerals such as $MgAl_2O_4$, Mg_2SiO_4, $CaTiO_3$, $Ca_2Al_2SiO_7$, etc. Siderophile elements

(Fe, Co, Ni, etc.) apparently were fractionated between 680 and 1050°K, by partial separation of metal and silicate. Redox conditions at this stage seem to have varied from class to class, as indicated by the Fe^{2+}/Mg^{2+} ratio in the silicates during fractionation: 0.14 ± 0.02 for ordinary, 0.00 ± 0.07 for enstatite, and 0.14 ± 0.08 or 0.08 ± 0.07 for carbonaceous chondrites. This fractionation may have been based on the ferromagnetic properties of the metal, since it apparently took place below the Curie point. Chondrule formation does not seem to have been causally related to either of these fractionations. It may have occurred at ~700°K during or after metal–silicate fractionation, presumably by partial remelting of the dust. It was followed by further condensation of volatiles and accretion. (auth) (UK)

25029 KINETIC MEDIUM ISOTOPE EFFECT IN NUCLEOPHILIC SUBSTITUTION. Beltrame, P.; Cattania, M. G.; Massolo, G.; Simonetta, M. (Univ., Milan). J. Chem. Soc., B; No. 3, 453-5(1970).

Kinetics of various kinds of nucleophillic substitution were studied in ethanol and in [hydroxy-$^2H_1$] ethanol in order to evaluate the rate ratios due to pure medium effects. The values of k_{EtOD}/k_{EtOH} were 1.84 and 1.83 for substitution of 1-chloro-2,4-dinitrobenzene and of 1-chloro-2,2-di-(p-nitrophenyl)ethylene, respectively, by ethoxide ion at 25°; 1.30 for substitution of 1-chloro-2,4-dinitrobenzene by pyridine at 90°; 1.3 to 1.4 for substitution, and 1.7 to 1.8 for elimination, in the concurrent reactions of n-butyl chloride with ethoxide ion at 60 to 80°. (auth) (UK)

25030 THE STRUCTURE OF TETRAKIS-(8-QUINOLINOLATO) BISDIMETHYL SULPHOXIDETHORIUM (IV). Singer, N. (Northern Polytechnic, London); Studd, B. F.; Swallow, A. G. J. Chem. Soc., D; No. 6, 342-3(1970).

X-ray diffraction studies of $Th(C_9H_6NO)_4-(Me_2SO)_2$ show that it is a nine-coordinate complex with a monocapped square antiprismatic structure in which one Me_2SO molecule is co-ordinated to the metal ion through its oxygen atom. (auth) (UK)

25031 STUDIES IN THE CHEMISTRY OF TECHNETIUM COMPLEXES OF TECHNETIUM(II), (III), AND (IV) WITH 1,2-BIS (DIPHENYLPHOSPHINO)ETHANE. Fergusson, J. E.; Hickford, Jeanette H. (Canterbury Univ., Christchurch, N. Z.). Aust. J. Chem.; 23: 453-61(Mar 1970).

Complexes of di- and tervalent technetium were prepared with 1,2-bis(diphenylphosphino)ethane (indexed as ethylenebis[diphenylphosphine]), viz, $[Tc(diphos)_2X_2]$ and $[Tc(diphos)_2Br_2]Br$ where X = Cl, Br. The complexes can be formulated as octahedral compounds. Both magnetic and spectral evidence agree with this approach. The quadrivalent technetium compounds $TcBr_4$, $TcBr_4(Ph_3P)_2$, and the salts $(diphos\text{-}H_2)TcX_6$ (X = Cl,Br) and Ag_2TcCl_6 were also prepared and are described. Attempts to prepare the trichloride ($TcCl_3$) are also reported. (Australia)

25032 SPECTROSCOPIC INVESTIGATIONS IN THE SYSTEM $(U_{0.5}Th_{0.5})O_{2.25}-ThO_2$ AND $UO_{2.25}-ThO_2$. Braun, Ruediger; Kemmler-Sack, Sibylle; Ruedorff, Walter. (Univ., Tuebingen, Ger.). Z. Naturforsch.; 25b: 424-6(Apr 1970). (In German).

Spectroscopic investigations on U(V) in oxide lattice showed that the optical behavior depends on ligand field symmetry. The coordination behavior of uranium in $UO_{2.25} = U_4O_9$ was studied. Graphs of reflection spectra are given. (M.C.G.)

25033 OPTIMUM CALCIUM CONCENTRATION FOR DETERMINING ROOT CATION EXCHANGE CAPACITY BY ISOTOPIC EXCHANGE. Carpenter, P. L. (Purdue Univ., Lafayette, Ind.); Lambeth, V. N. J. Amer. Soc. Hort. Sci.; 94: 645-6(1969).

Calcium adsorption on the root exchange sites of 4 vegetables as determined by the isotopic exchange method ($^{40}Ca-^{45}Ca$) was a function of its concentration in the external solution surrounding the roots. As the Ca concentration was increased over the range 0.2 me to 8.0 me Ca/l, there was an increase in the Ca adsorbed on roots of sweet corn, cv. "Gold Rush," garden bean cv. "Topcrop," lettuce cv. "Bibb" and cabbage. The Ca adsorption curve of all 4 vegetables showed a plateau between concentrations of 1 and 2 me Ca/l. Root CEC values obtained at Ca concentrations corresponding to this plateau compare closely with values reported by other methods, and are more representative of established CEC values than those reported where the Ca concentration in the external solution was 0.5 me Ca/l. (auth)

25034 A PROCESS FOR THE PRODUCTION OF NUCLEAR FUEL NITRIDES FROM FLUORIDES. (to Nuklear-Chemie und-Metallurgie Gesellschaft mit Beschrankter Haftung). British Patent 1,186,630. 2 Apr 1970. Priority date 9 Aug 1967, Germany.

A process is described for the production of uranium nitride or plutonium nitride or mixtures of these or in admixture with zirconium nitride by high-temperature (750 to 1050°C) ammonolysis of the corresponding fluoride or mixtures of fluorides or the corresponding ammonium double fluoride or mixtures of ammonium double fluorides to yield the higher nitrides, which are then dissociated in vacuo to the corresponding mononitride or mixture of mononitrides. Alternately, a higher fluoride or mixture of higher fluorides can be reduced to a lower fluoride before reaction with ammonia. (B.L.M.)

25035 ISOTOPIC EXCHANGE REACTIONS IN UNIMOLECULAR FILMS. Cooke, William R. F. Montreal; McGill Univ. (1969).

Thesis.

Surface pressure-area isotherms of 3-iodooctadecanoic acid and 9- and 10-iodooctadecanoic acid monolayers were determined. These two compounds were found to yield unimolecular films of the liquid expanded type. Isotopic exchange reactions of monolayers of 3-iodooctadecanoic acid tagged with iodine-131 with substrate iodide were investigated as a function of temperature, substrate iodide ion concentration, and monolayer concentration. The reaction was found to be first order in substrate iodide and monolayer concentration. An activation energy of 28.4 kcal/mole was calculated for the reaction. Exchange with substrate iodide was found to be completely absent in films of 9- and 10-iodooctadecanoic acid tagged with iodine 131. By observing the decrement in count rate over active films on iodide free substrates, solution was found to take place in collapsed films of 3-iodooctadecanoic acid and all films of 9- and 10-iodooctadecanoic acid. (Diss. Abstr.)

25036 IMPROVEMENTS IN OR RELATING TO ZIRCONIUM COMPOUNDS. Woodhead, James Louis (to United Kingdom Atomic Energy Authority). British Patent 1,181,794. 18 Feb 1970. Filed 9 Jun 1966.

The preparation of zirconium nitrates and their compounds by the sol-gel technique is described. The water-based sol or gel obtained comprises Zr and NO_3 ions with NO_3/Zr molar ratio between 1.0:1 and 1.1:1. The method comprises mixing together the required proportions of Zr hydroxide or carbonate, water, and HNO_3 and heating the mixture. The product may also include added $Ca(NO_3)_2$ or $Y(NO_3)_3$ as stabilizer. The sol prepared in this way may be dried at 80° to 90°C to produce a water redispersible gel, or it may be suspended in an inert liquid and a soluble amine added, whereby irreversible denitration of the sol takes place. The product appears to contain the cyclic tetramer $[Zr_4(OH)_8]^{8+}$, and it contains lattice water and both covalent and ionic nitrate. It would appear to be a large cationic polymer containing equimolar amounts of NO_3 and Zr in which the tetrameric units are joined by nitrato and diol bridges. Another method of preparation is to wash the Zr hydroxide well with water, and then take it up with basic Zr nitrate. The effect on viscosity of alterations in the NO_3:Zr proportions is shown. The sol is completely stable even at molarities of 4 and above and centrifugation caused no reparation even at 3700 rpm for 30 min. The gel may be denitrated by heating at about 500°C and the product then calcined at a higher temperature in air to give ZrO_2. The calcining temperature should be chosen with regard to the properties, such as surface area, that are required. The sol can be used to plasticize ZrO_2 to permit it to be extruded. Experimental work is described, including a method for the production of ZrO_2 spheres. (UK)

25037 METHANE CRACKING BY NUCLEAR REACTOR HEAT. Schulten, R.; Kugeler, K. (Kernforschungsanlage, Juelich, Ger.). Chem.-Ing.-Tech., 41: 1132-3(Oct. 1969). (In German).

A method for the cracking of methane using heat from the helium of a pebble bed reactor was proposed. Reaction equations and thermodynamic data indicate that almost all the methane would be converted into hydrogen and carbon dioxide. An installation for such a cracking procedure was sketched. Cost estimations using reactor heat for methane cracking were compared with chemical processes. The data are tabulated, and the cost of the hydrogen produced is given as a function of the CH_4 price. (J.S.R.)

25038 CORRELATION OF ENTHALPY AND ENTROPY IN SUFFICIENTLY EQUIVALENT SYSTEMATIC ERRORS; VAPORIZATION OF URANIUM. Thorn, R. J. (Argonne National Lab., Ill.). J. Chem. Phys.; 52: 74-6(1 Jan 1970).

A brief review of the published values of the vapor pressure and enthalpy of vaporization of uranium is presented. Some explanation of the effects of various contaminants (particularly O) on these values is included. (B.L.M.)

25039 CD_4: CRYSTAL STRUCTURE AND SOLID PHASE DIAGRAM WITH AR. Greer, Sandra C.; Meyer, Lothar (Univ. of Chicago). J. Chem. Phys.; 52: 468-9(1 Jan 1970).

The crystal structure of CD_4 and CD_4 + Ar is reported. The carbon lattices of CD_4 are face-centered cubic over the temperature range of 4.2 to 80°K with no change with time noted over several days. The lattice constants for the face-centered CD_4 as a function of temperature are shown graphically. The solid temperature-composition phase diagram for CD_4 + Ar is shown and resembles that for CH_4 + Ar with the critical point for unmixing occurring at the same composition (65 ± 2% Ar) but at a slightly lower temperature. (B.L.M.)

25040 ISOTOPIC EXCHANGE IN OLEFIN ION-MOLECULE REACTIONS. Henis, J. M. S. (Monsanto Co., St. Louis). J. Chem. Phys.; 52: 292-8(1 Jan 1970).

Isotopic exchange was examined in the products of ion-molecule reactions involving deuterated and undeuterated olefins. The results were used to obtain information regarding the structure of reaction intermediates, and the factors governing H-D exchange. Analysis of product distributions in mixtures of 2-C_4D_8 with various pentenes and hexenes suggested quite specific structures for the reaction intermediates that were in good agreement with earlier work on undeuterated systems. In addition it was found that different products, which almost certainly arose from the same intermediate, showed significantly different degrees of H-D exchange. (auth)

25041 ESR OF THE CN RADICAL IN INERT MATRICES. Easley, Warren C.; Weltner, William Jr. (Univ. of Florida, Gainesville). J. Chem. Phys.; 52: 197-205(1 Jan 1970).

CN was trapped as a randomly oriented molecule in argon, krypton, and neon matrices at 4°K. The ESR spectra of $^{12}C^{14}N$ and $^{13}C^{14}N$ in their ground $^2\Sigma^+$ states were determined and yeild the following magnetic parameters in solid argon: $g_{||} = 2.0015(5)$, $g_\perp = 2.0003(5)$, $A_{||}(^{14}N) = +18.2(4)$ MHz, $A_\perp(^{14}N) = -28.0(3)$ MHz, $A_{||}(^{13}C) = +678(1)$ MHz, $A_\perp(^{13}C) = +543.1(5)$ MHz. Weak forbidden $\Delta M_I = \pm 1$ transitions were also observed. On slight warming, the sites were irreversibly changed so that CN thereafter exhibited hindered rotation, even at 4°K, and raising the temperature led to the isotropic ESR spectrum of rotating CN. Variations in linewidths due to motional effects made it possible to confirm the relative signs of the A values. The $g_\perp$ shift was shown to arise from small negative contributions from spin-orbit coupling with both the $^2\Pi_i$ and $^2\Pi_r$ excited states. Approximate spin densities in the molecule are $q_C(2s) = 0.19$, $q_C(2p) = 0.48$, $q_N(2p) = 0.32$, $q_N(2s) = -0.008$. These values were compared with those obtained from a Hartree-Fock wavefunction provided by Cade. (auth)

25042 EXPERIMENTAL STUDY OF THE HIGHER $\pi \rightarrow \pi^*$ TRANSITIONS OF BENZENE IN LOW-TEMPERATURE MATRICES. Katz, Benjamin (Tel-Aviv Univ., Israel); Brith, Malka; Sharf, Benjamin; Jortner, Joshua. J. Chem. Phys.; 52: 88-102 (1 Jan 1970).

The results of an experimental study of the absorption spectrum of benzene and deuterated benzenes in solid Ar, Kr, Xe, and N_2 in the spectral region 2800-1700 Å are presented, with special reference to the 2100- and to the 1850-Å transitions. On the basis of the observed vibrational structure the second excited singlet state of the benzene molecule is assigned to the $^1A_{1g} \rightarrow {}^1B_{1u}$ rather than to the $^1A_{1g} \rightarrow {}^1E_{2g}$ excitation. Theoretical calculations of the dynamic electronic-vibrational coupling between the $^1B_{1u}$ and the $^1E_{1u}$ states support the $^1B_{1u}$ assignment of the 2100-Å transition. The vibrational structure of the 1850-Å $^1A_{1g} \rightarrow {}^1E_{1u}$ transition was resolved. No experimental evidence for Jahn-Teller coupling in the $\pi \rightarrow \pi^*$ $^1E_{1u}$ state was observed, in agreement with theoretical analysis. Information on site splittings for the higher $\pi \rightarrow \pi^*$ excitation of benzene in rare-gas solids has accumulated. Analysis of matrix shifts for the $^1A_{1g} \rightarrow {}^1B_{1u}$ and $^1A_{1g} \rightarrow {}^1E_{1u}$ transitions indicates that the "solvent effect" is dominated by dispersion interactions. Information on deuteration effects on the $^1B_{1u}$ and $^1E_{1u}$ energy levels was obtained. Qualitative information on intramolecular radiationless decay in the two higher $\pi \rightarrow \pi^*$ excited states of the benzene molecule was inferred from the linewidths in the absorption spectrum. (auth)

25043 TRANSPORT OF QUASILOCALIZED EXCITONS IN MOLECULAR CRYSTALS. Munn, R. W.; Siebrand, W. (National Research Council of Canada, Ottawa). J. Chem. Phys.; 52: 47-63 (1 Jan 1970).

A model is presented for electron-phonon coupling in molecular crystals and its effect on transport of excitons and charge carriers in aromatic hydrocarbon crystals. The model differs from the usual ones in that the coupling is taken quadratic instead of linear in the vibrational coordinates. It is shown that this coupling dominates in aromatic hydrocarbons, leading to large frequency shifts in out-of-plane molecular vibrations on electronic excitation or ionization. The present study is limited to weak intermolecular electronic coupling, implying quasilocalized excitons (or electrons). There are then two limiting modes of diffusion, governed by the rate either of exciton transfer between molecules or of phonon transfer. In either limit, at high temperatures, transport occurs by incoherent jumps between adjacent molecules (hopping) and increases or decreases gently with temperature, while at low temperatures, coherent transport decreasing rapidly with increasing temperature occurs. The diffusion coefficient is larger for normal than for deuterated aromatic hydrocarbons except for hopping transport in the slow-exciton limit. The observed temperature dependence and deuterium effect of triplet exciton diffusion in the c′ direction of anthracene are reproduced by the model in this case. The transition for hopping to coherent diffusion is not readily observable for anthracene, but may be observable for naphthalene or benzene. Preliminary results indicate that the model also accounts satisfactorily for the magnitude and temperature dependence of charge-carrier mobilities in anthracene. (auth)

25044 REACTION KINETICS OF URANIUM AND DEUTERIUM. Alire, R. M.; Mueller, B. A.; Peterson, Chalres L.; Mosley, John R. (Los Alamos Scientific Lab., N. Mex.). J. Chem. Phys.; 52: 37-46(1 Jan 1970).

A uniform and adherent layer of β-UD_3 was formed on U when U reacted with D in the temperature range 175 to 350°C and pressure range 100 to 10270 torr. The rate of reaction was controlled by diffusion of D across this product layer. Reproducible results were obtained only with D_2 of very high purity because low-level impurities had a profound effect on the rate of reaction. It was concluded that molecular diffusion may also be occurring. The activation energy for molecular diffusion with Langmuir sorption of D_2 on UD_3 was determined to be 9.8 ± 0.5 kcal/mole D_2. The activation energy for atomic diffusion was determined to be 4.4 ± 0.3 kcal/g-atom of D. (auth)

25045 INFRARED SPECTRUM OF MATRIX-ISOLATED CYANATE ION. I. VIBRATIONAL ANALYSIS, BANDWIDTHS, AND ABSOLUTE INTENSITIES IN POTASSIUM HALIDES. Schettino, V.; Hisatsune, I. C. (Pennsylvania State Univ., University Park). J. Chem. Phys.; 52: 9-27(1 Jan 1970).

Solid solutions of the cyanate ion in KCl, KBr, and KI matrices were prepared by heating standard infrared pressed disks. The infrared spectra of these disks were measured from 5000 to 400 cm^{-1} and analyzed. The frequency data are in excellent agreement with those obtained from doped single crystals by earlier investigators. Anharmonicity constants, harmonic frequencies, and force constants were calculated for the isotopic species $^{16}O^{12}C^{14}N^-$, $^{16}O^{13}C^{14}N^-$, $^{16}O^{13}C^{15}N^-$, and $^{18}O^{12}C^{14}N^-$. The anharmonicity constants are essentially independent of the matrix, and only quadratic force-constant changes appear necessary to account for the frequency shifts of the fundamentals as the matrix is varied. The temperature dependence of the bandwidths and peak frequencies of the fundamentals have been studied in the range from 95 to 530°K. The fundamentals in all matrices can be represented well by Lorentz band shapes. The absolute band intensities were also measured. In addition to bands arising from the internal modes of the cyanate ion, combination bands of the intense cyanate fundamentals with external modes of the cyanate and with lattice modes of the host matrix were observed. (auth)

25046 1,3,5-TRINEOPENTYLBENZENE. IV. HYDROGEN ISOTOPE EFFECTS IN THE POSITIVE BROMINATION OF 2-CHLORO-, 2-BROMO-, AND 2-IODO-1,3,5-TRINEOPENTYLBENZENE. Marton, Jozsef (Univ. of Goteborg. Chalmers Inst. of Tech., Goteborg). Acta Chem. Scand.; 23: 3321-8(1969).

2-Chloro-, 2-bromo-, and 2-iodo-1,3,5-trineopentylbenzene were brominated with positive bromine derived from silver perchlorate and molecular bromine in a solvent system containing a large amount of acetic acid and small amounts of dioxane and water. Competitive experiments with partially deuterated compounds gave isotopic rate ratios k_D/k_H = 0.79 ± 0.02, 0.73 ± 0.04 and 0.67 ± 0.04, respectively, for the bromination of the above compounds at room temperature. The results are discussed in terms of a steric repulsion effect increasing gradually with the spatial requirements of the 2-halogen substituents, and in terms of an early-transition-state model for positive bromination. (auth)

25047 1,3,5-TRINEOPENTYLBENZENE. V. HYDROGEN ISOTOPE EFFECTS IN THE CHLORINATION, BROMINATION, AND POSITIVE IODINATION OF 1,3,5-TRINEOPENTYLBENZENE. Marton, Jozsef (Univ. of Goteborg. Chalmers Inst. of Tech., Goteborg). Acta Chem. Scand.; 23: 3329-36(1969).

1,3,5-Trineopentylbenzene was chlorinated and brominated by molecular species in dimethylformamide and iodinated by positive iodine derived from silver perchlorate and molecular iodine in an acetic acid-dioxane (10:1 v/v) solvent. Competitive experiments with the ordinary hydrocarbon and its d_3 nuclear derivative gave the isotopic rate ratios $k_D/k_H = 0.99 \pm 0.03$, 0.91 ± 0.02, and 0.38 ± 0.02 for chlorination, bromination, and positive iodination, respectively. The results are discussed in terms of probable differences in the energy profile for chlorination, bromination, and iodination of aromatic compounds and of steric repulsion imposed around the reaction site. (auth)

25048 VAPOR PRESSURE ISOTOPE EFFECT IN MIXING ASSOCIATION. VAPOR PRESSURE INVESTIGATIONS ON MIXTURES OF METHYLAMINE AND N-DEUTEROMETHYLAMINE WITH TRIMETHYLAMINE. Wolff, H.; Wuertz, R. (Univ., Heidelberg). Z. Phys. Chem. (Frankfurt); 67: 115-21(Sep 1969). (In German).

In the temperature range from −20 to −50°C, isothermic curves were determined for the vapor pressure of mixtures containing methylamine or N-deuteromethylamine with trimethylamine. From the isothermic curves, the partial pressure quotients were derived. Results showed a normal isotope effect on vapor pressure, D-compound smaller than H-compound, even at the lowest dilutions with trimethylamine. Failure to find the inverse effect was explained by the assumption that, instead of decomposition to monomeres, mixing association occurred with the solvent. (tr-auth)

25049 DIFFUSION OF HYDROGEN AND DEUTERIUM IN TANTALUM. Zuechner, H.; Wicke, E. (Univ., Muenster, Ger.). Z. Phys. Chem. (Frankfurt); 67: 154-8(Sep 1969). (In German).

On tantalum foils of 99.9% purity, either hydrogen or deuterium was electrolytically deposited. Penetration of the gases was determined by x-ray interference-goniometry. The diffusion coefficients found were 1.3 times 10^{-6} for hydrogen and 1.4 times 10^{-6} cm^2/sec for deuterium. Thus, no definite isotope preference was observed with respect to diffusion, at least not at normal temperatures. (H.B.G.)

25050 LATTICE CONSTANT AND VOLUME EXPANSION FACTOR DEPENDENCE ON ISOTOPE COMPOSITION. Baikov, Yu. M.; Ryskin, G. Ya.; Stepanov, Yu. P.; Subashiev, A. V.; Korenblit, I. Ya.; Klochikhin, A. A. (Ioffe Physicotechnical Inst., Leningrad). Sov. Phys.-Solid State (Engl. Transl.); 11: 2480-2(Apr 1970).

Translated from Fiz. Tverd. Tela; 11: 3050-2(Oct 1969).

Thermal expansion factors and densities of LiH, LiD, ^{6}LiF, and ^{7}LiF crystals were measured using flotation in organic fluids. The isotope effect was large for LiH and small for LiF. The change in lattice constants was calculated to be 0.00317 for LiH−LiD and 0.0001 for ^{6}LiF−^{7}LiF. The experimental results were compared with theoretical calculations; the agreement was good. (D.L.C.)

25051 ANOMALOUS CHANGES OF SOME PROPERTIES OF BORON. Bigvava, A. D.; Dzhamagidze, Sh. Z.; Kunchuliya, E. D.; Moiseenko, S. S.; Shvangiradze, R. R. Sov. Phys.-Solid State (Engl. Transl.); 11: 2413-14(Apr 1970).

Translated from Fiz. Tverd. Tela; 11: 2981-3(Oct 1969).

Results are presented of anomalous changes with temperature in the electrical resistivity, the optical absorption coefficient in the impurity region, and the interplanar distances in various directions (hkl) in zone-refined specimens of β-rhombohedral boron. The effect is attributed to the segregation of an impurity phase in the material at a particular temperature. (auth)

25052 ON THE EFFECT OF DEUTERATION ON NON-RADIATIVE PROCESSES IN LARGE MOLECULES. Sharf, B.; Silbey, R. (Massachusetts Inst. of Tech., Cambridge). Chem. Phys. Lett.; 5: 314-16(15 Apr 1970).

It is shown that the nonradiative decay of the fluorescing state of large polyatomic molecules might exhibit an inverse or retarded deuteration effect. (auth)

25053 THE ANOMALOUS DEUTERIUM ISOTOPE EFFECT ON THE CHEMICAL SHIFT OF THE BRIDGE HYDROGEN IN THE ENOL TAUTOMER OF 2,4-PENTANEDIONE. Chan, Sunney I.; Lin, L.; Clutter, Dale; Dea, Phoebe (California Inst. of Tech., Pasadena). Proc. Nat. Acad. Sci. U. S.; 65: 816-22(Apr 1970).

The nature of the intramolecular hydrogen bond in the enol tautomer of 2,4-pentanedione was investigated by high resolution proton and deuteron magnetic resonance spectroscopy. An unusually large deuterium isotope effect on the chemical shift of the bridge hydrogen was observed. This unexpected result, together with the observation of a pronounced temperature dependence for both the proton and deuteron resonances, suggests that two states with different chemical shifts for the bridge hydrogen are involved in rapid equilibrium and that the anomalous deuterium isotope effect has its origin in the effect of deuterium substitution on the energy separation between these states. It is proposed that these states correspond to the symmetrical and asymmetrical structures of the intramolecular hydrogen bond. (auth)

25054 DIRECT CURRENT-VOLTAGE CHARACTERISTICS OF CALCIA STABILIZED ZIRCONIA WITH POROUS PLATINUM ELECTRODES. Yanagida, Hiroaki; Brook, R. J.; Kroeger, F. A. (Univ. of Southern California, Los Angeles). Contract AF-AFOSR-68-1405. J. Electrochem. Soc.; 117: 593-602(May 1970).

The direct current-voltage characteristics of symmetrical cells Pt, O_2(I), $|Zr_{0.85}Ca_{0.15}O_{1.85}|$Pt, O_2(II), with $pO_2(I) = pO_2(II)$, were measured at 560°C under oxygen pressures from 1 to 10^{-20} atm. The characteristics were nonohmic, the deviation from ohmic law being mainly due to the potential drop at the cathode interface between the solid electrolyte and the gas ambient. The characteristics consist of two parts. The first is characterized by a marked oxygen pressure dependence and is observed at voltages lower than approximately 2V (weak polarization). In this range, the rate-determining process is the diffusion of oxygen atoms (resulting from dissociation of O_2 or H_2O) through the platinum of the Pt paste electrode. The second part of the characteristic is almost independent of the oxygen pressure and is observed at voltages higher than approximately 2V (strong polarization). Here the rate-determining step is the process in which neutral oxygen atoms, adsorbed at the cathode surface of the electrolyte, combine with effectively neutral oxygen vacancies V_O^x, (oxygen ion vacancies which have trapped two electrons) to form a normal O^{2-} lattice ion (O_O^x). This process utilizes the part of the electrolyte surface not in contact with the platinum, but close to points where the platinum makes contact, and involves migration of electrons from the platinum over the surface of the electrolyte. (auth)

25055 ELECTRODE OVERVOLTAGES IN MOLTEN FLUORIDES. THE CORROSION OF ZIRCONIUM ELECTRODES IN MOLTEN KHF_2. Pizzini, S.; Sternheim, G. (EURATOM–CCR, Petten, Netherlands). J. Electrochem. Soc.; 117: 647-51(May 1970).

Corrosion and polarization experiments were carried out on zirconium electrodes in molten KHF_2. Overvoltage measurements were made using the galvanostatic method. In the cathodic polarization of Zr electrodes plotted values indicated a limiting current at about 1×10^{-2} A/cm^2 and a small plateau at about −1700 mV. The presence of a film of potassium metal was revealed after polarization at about −2000 mV. When anodically polarized, the electrode eventually passivates. The results of corrosion experiments at various cathodic polarizing currents are reported. Possible reactions are discussed. The corrosion current under conditions of spontaneous corrosion averaged 3.96×10^{-2} A/cm^2. (J.G.B.)

25056 FACTORS AFFECTING THE GROWTH OF POROUS ANODIC OXIDE FILMS ON ZIRCONIUM. Cox, B. (Atomic Energy of Canada Ltd., Chalk River, Ont.). J. Electrochem. Soc.; 117: 654-63(May 1970).

Although anodization of zirconium and its alloys generally results in the formation of barrier-type films, porous anodic oxide films can be produced in some electrolytes and by some preparation techniques. A survey of common electrolytes reveals that those containing nitrate, chromate, dichromate, and phosphate ions commonly lead to porous anodic films. An electron microscope study of the films produced in these electrolytes, and others giving barrier-type films, showed that no single explanation fits all instances of porous film formation. While incorporation of the electrolyte anion in the oxide may be the primary factor influencing the formation of porous oxide films, it appears to operate primarily by affecting the local transport of oxygen ions through the films. This effect may be achieved by influencing the crystallization of the oxide during growth so that in some instances local oxidation and cracking occur at grain boundaries, while in other instances it leads to the general development of a porous structure. (auth)

25057 THE DEPOSITION OF MOLYBDENUM AND TUNGSTEN FILMS FROM VAPOR DECOMPOSITION OF CARBONYLS. Kaplan, L. H. (East Fishkill Lab., Hopewell Junction, N. Y.); d'Heurle, F. M. J. Electrochem. Soc.; 117: 693-700(May 1970).

Molybdenum and tungsten films formed by the pyrolytic decomposition of the respective carbonyls were investigated to determine their usefulness as conductors in microcircuit devices. The relations between deposition variables (such as pressure of carbonyls, pressure of the carrier gas, rate of gas flow, and substrate temperature) and deposition parameters (such as rate of film growth) or film properties (such as resistivity) were studied. The effects of carrier gas substitution on molybdenum film resistivity were determined. At a carbonyl pressure of 0.001 torr, a hydrogen pressure of 0.01 torr, a gas flow of 12 std cc/min, and a substrate temperature of 500°C, molybdenum films were deposited with a resistivity close to that of bulk (5.6 μohm cm), at a rate of 3.7 Å/sec. In molybdenum films deposited at lower substrate temperatures the resistivity increased, presumably because of increased carbon within the films. The resistivity of tungsten film is always greater than the resistivity of Mo films deposited under equivalent conditions. The lowest resistivity achieved in a tungsten film was approximately twice the value for bulk tungsten (5.5 μohm cm). The structures of both molybdenum and tungsten films deposited under conditions that favored the formation of films with the lowest resistivities were examined by x-ray diffraction as well as replica electron microscope techniques. Measured lattice parameters, when corrected for independently determined stress, were approximately equal to the parameters reported for pure molybdenum and tungsten. In all tungsten films studied, tensile stresses were found, but in molybdenum films the stresses were tensile for substrate temperatures greater than 500°C and compressive for lower temperatures. (auth)

25058 STUDIES OF THE ADSORPTION OF URANIUM HEXAFLUORIDE ON MAGNESIUM FLUORIDE AND NEPTUNIUM HEXAFLUORIDE ON MAGNESIUM AND BARIUM FLUORIDES. Matcheret, G. (Centre d'Etudes Nucleaires, Fontenay-aux-Roses, France). Radiochem. Radioanal. Lett.; 3: 287-94(24 Apr 1970). (In French).

A volumetric method was used to study the adsorption of UF_6 on MgF_2 at 20°C. The isothermal curve obtained was characteristic of a physical monolayer monomolecular adsorption. Analogous to UF_6 the adsorption of NpF_6 involved, in addition, a chemical reduction with probable formation of NpF_5 and release of fluorine. The reaction of NpF_6 with BaF_2 allowed confirmation of the influence of the polarizing power of the Ba^{2+} ion on formation and stability of the product of addition. (auth)

25059 VOLATILIZATION OF CHLORIDES OF CIS- AND TRANSURANIUM ELEMENTS IN A TUBE WITH A TEMPERATURE GRADIENT. Merinis, J.; Legoux, Y.; Bouissieres, G. (Institut de Physique Nucleaire, Orsay, France). Radiochem. Radioanal. Lett.; 3: 255-61(24 Apr 1970). (In French).

Studies were made on the volatilization of Ra, Ac, Th, Pa, U, Np, Pu, Am, Cm, Bk, and Cf. Data are tabulated for temperature, carrier gas, temperature of precipitation, and probable chemical state of the volatilized product. The temperature of precipitation of the elements studied is reported as a function of the atomic number by stating precisely the valence of each one. It was found that for the same degree of chlorination: 3 or 4, the transuranium elements are fixed in the same zone of the tube, since the cis-uranium elements are precipitated at a higher temperature. (P.C.H.)

25060 KINETIC STUDIES ON ISOTOPIC EXCHANGE BETWEEN NEODYMIUM ION AND ITS DIETHYLENETRIAMINEPENTAACETIC ACID COMPLEX. Asano, T.; Okada, S.; Taniguchi, S. (Radiation Center of Osaka Prefecture). J. Inorg. Nucl. Chem.; 32: 1287-93(Apr 1970).

In the course of a study of the β-decay effects of the chelate compound ^{149}NdDTPA in aqueous solution, the decay effects were found to be closely related to an isotopic exchange reaction, and for better understanding of the β-decay effects, knowledge of the isotopic exchange reaction was essential. The isotopic exchange reaction between neodymium ion and its DTPA complex in aqueous solution was studied over the concentration range $1 \times 10^{-4}\underline{M}$ to $1 \times 10^{-3}\underline{M}$ of each reactant and pH range 5.5 to 7.0. The rate was found to be proportional to $[NdY]^{1.0}$, $[Nd^{3+}]^{0.3-1.0}$, and $[H^+]^{2.0-0.3}$ (Y is the DTPA ligand) and was expressed by: $R\ M\ min^{-1} = k_1[NdY][Nd^{3+}] + k_2[NdY][H^+][Nd^{3+}] + k_4[NdY][H^+]^2 + k_5[NdY][H^+]^3$, where k_1, k_2, k_4 and k_5 are $0.35\ M^{-1}\ min^{-1}$, $3.4 \times 10^5 M^{-2}\ min^{-1}$, $1.1 \times 10^8 M^{-2}\ min^{-1}$ and $1.4 \times 10^{13} M^{-3}\ min^{-1}$ at 25°C in 0.01 $\underline{M}$ ammonium acetate buffer solution. A monoprotonation process could not be observed. In acid solution the exchange reaction proceeds by protonation and bimolecular collision processes. In neutral solution the bimolecular collision process is predominant. Although a dependence of the rate on the hydrogen ion concentration was also observed in neutral solution, it is not attributed to the protonation process but to the bimolecular collision process in which hydrogen ions participate. (auth) (UK)

25061 URANIUM-OXYGEN LATTICE VIBRATIONS OF LITHIUM, β-SODIUM, AND β-STRONTIUM URANATES. Ohwada, Ken (Japan Atomic Energy Research Inst., Ibaraki). J. Inorg. Nucl. Chem.; 32: 1209-18(Apr 1970).

Infrared spectra of Li_2UO_4, β-Na_2UO_4, and β-$SrUO_4$ were measured in the region from 4000 to 380 cm^{-1} and a normal coordinate analysis of the optically active U–O lattice vibrations of such compounds was made on the basis of a simple layer model of infinite $[(UO_2)O_2]_\infty$. Based on the results of this treatment some of the observed bands were assigned to the U–O lattice vibrations. The force constants of U–O bonds and angles were obtained and are discussed. (auth) (UK)

25062 STUDIES ON URANYL COMPLEXES. IV. SIMPLE AND POLYNUCLEAR URANYL COMPLEXES OF SOME POLYAMINOCARBOXYLIC ACIDS. Frausto da Silva, J. J. R.; Simoes, M. Lourdes Sadler (Centro de Estudos de Quimica Nuclear, Lisbon). J. Inorg. Nucl. Chem.; 32: 1313-22(Apr 1970).

The uranyl complexes of methyliminodiacetic acid, N-hydroxyethyliminodiacetic acid, ethylenediamine-N,N′-diacetic acid, and ethyleneglycol bis(aminoethyl ether)-tetraacetic acid were studied by potentiometry. Stability constants of 1 : 1 and 2 : 1 metal-to-ligand chelates were determined, as well as their hydrolysis and polymerization constants. Possible structures for these species are discussed; data seem to support an equatorial coordination number of five for the UO_2^{2+} cation in these complexes. (auth) (UK)

25063 INVESTIGATION OF COMPLEX FORMATION BETWEEN NEPTUNIUM(IV) AND ACETYLACETONE BY SOLVENT EXTRACTION. Liljenzin, J. O.; Stary, J. (Chalmers Univ. of Tech., Goteborg). J. Inorg. Nucl. Chem.; 32: 1357-63(Apr 1970).

The distribution of neptunium(IV) between organic solvents (benzene, carbon tetrachloride, cyclohexane and n-hexane) containing acetylacetone indexed as 2,4-pentanedione and 1$\underline{M}$ sodium perchlorate solution was investigated using the AKUFVE-method (see Acta Chem. Scand., 23: 2781(1969)). The dependence on hydrogen ion, reagent, and metal concentrations at various temperatures is described. From the results obtained the stability constants, distribution, and thermodynamic constants of the neptunium(IV)–acetylacetonate complexes were determined. (auth) (UK)

25064 SOME RECENT RESULTS IN INORGANIC PAPER CHROMATOGRAPHY AND ELECTROPHORESIS. Lederer, M. (CNR, Rome). pp 11-19 of Chromatographie Electrophorese. Bruxelles; Presses Academiques Europeennes (1969).

From 5th International Symposium on Chromatography and Electrophoresis, Brussels, Belgium. See CONF-680971.

Recent studies in inorganic paper chromatography and electrophoresis are reviewed. Chromatographic investigations of reactions are given particular attention. Paper chromatographic studies indicated that pertechnetate (TcO_4^-) reduces in HCl or HBr via an intermediate valency that is very stable in HCl and less so in HBr to form mixtures of Tc(IV) halo-aquo complexes, the bromo-complexes being less stable than the corresponding chloro-complexes. Results of paper electrophoretic studies on the formation of outer-sphere complexes of $Co(NH_3)_6^{3+}$, CNS^-, $Os(CN)_6^{4-}$, $Ru(CN)_6^{4-}$, and $Fe(CN)_6^{4-}$ in various electrolytes are given. (J.G.B.)

25065 STUDY OF TITANIUM AND ZIRCONIUM COMPLEXES WITH OXYACIDS BY THE EXTRACTION METHOD. Pyatnitskii, I. V.; Grigalashvili, K. I. (Tbilisi State Univ., USSR). Soobshch. Akad. Nauk Gruz. SSR; 57: 53-6(Jan 1970). (In Russian).

The composition and stability of titanium complexes with glyceric, glycolic, and dihydroxytartaric (indexed as tetrahydroxysuccinic) acids and zirconium complexes with lactic acids were studied by the extraction method in a large interval of pH. The constants of hydrolytic instability were calculated. (auth)

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Refer also to abstract 26295.

25066 (AD-700348) MECHANISM OF IONIZING-RADIATION ACTION ON SULFOCATIONS. Tulupov, P. E.; Bychkov, N. V.; Kasperovich, A. I.; Roginskaya, B. S. Translated from pp 125-33 of Sintez i Sovystva Ionoobmennykh Materialov, Moscow, 1968. 16p. (FSTC-HT-23-141-70). CFSTI.

An investigation was made of the mechanism of the exchange capacity reduction in sulfopolystyrene cation exchangers during irradiation in water. (auth) (TSS)

25067 (DP-1205) CHEMICAL EFFECTS IN MICROMOLAR NITRIC ACID FROM GAMMA RADIATION AND HEATED ALUMINUM. A LABORATORY STUDY WITH APPLICATION TO SRP REACTORS. Baumann, Elizabeth W. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Jan 1970. Contract AT(07-2)-1. 21p. Dep. CFSTI.

The effects of gamma radiation and heated aluminum on 20μ$\underline{M}$ HNO_3 were studied to determine the causes of occasional pD instability in the D_2O moderator of the Savannah River reactors. At doses of 5 × 10^6 rad, 70% of the initial concentration of the nitric acid (helium-saturated) was maintained. When hydrogen or organic reducing agents were present, all the nitric acid was lost at doses below 2 × 10^5 rad. Freshly cleaned aluminum at 100°C, contacted with stirred air-free solutions at 75°C, caused a loss of >80% of the H^+ and 50% of the NO_3^- in one hour. Treating the aluminum with lithium silicate solution reduced these acidity losses to 30%. (auth)

25068 (SC-T-70-4014) MICROSYNTHESIS OF TRITIATED PARAPOLYPHENYL WITH A VERY HIGH SPECIFIC ACTIVITY. Peters, J. M.; Guillaume, M. Translated by Marcel I. Weinreich (Sandia Labs., Albuquerque, N. Mex.), from J. Label. Compounds; 5: 72-9(Jan-Mar 1969). 10p. Dep. CFSTI.

The parapolyphenyl $(C_6H_4)_n$ presents a great thermal and molecular stability (benzene ring), allied to a high hydrogen content. These characteristics justify an attempt at tritiating this polymer to a very high specific activity. Thus tritiated, the latter may lend itself to being utilized as a target for the production of 14-MeV neutrons in small accelerators. Two microsyntheses were undertaken, leading to specific activities of 17 and 31 Ci/mM. The isotopic yields and autoradiolysis of these polymers were tested and evaluated. (auth)

25069 ANALYTICAL METHOD FOR DETERMINING RATE CONSTANTS USING A PERIODICAL IRRADIATION TECHNIQUE. Kawakami, W.; Isbin, H. S. (Univ. of Minnesota, Minneapolis). Can. J. Chem.; 47: 4531-35(15 Dec 1969).

A new analytical method is presented for the determination of rate constants using a periodical irradiation technique. This method is applicable to reactions which have both a first and a second order termination for the chain radical concentration, and is illustrated for the radiolysis of aqueous solutions of chloral hydrate by ^{137}Cs γ rays. The apparent rate constant of first order termination and the mean chain life time of the chain radical were determined to be 1.10 s^{-1}, and 0.25 s for 400 rad/min, at 22°C, respectively. (auth) (Canada)

25070 EXPERIMENTS WITH OPTICALLY ACTIVE MATERIALS IRRADIATED BY FAST NEUTRONS. Sellerio, A.; De Lisi, S.; Romano, M. C.; Sinagra, E. Atti Accad. Sci. Lett. Arti Palermo; 28: 3-18(1967-68). (In Italian).

Optically active materials were irradiated with fast neutrons. It is concluded that no effect appears when the rotatory power is stable, whereas, some modification appears when the optical activity is time-dependent. (auth)

25071 FREE RADICALS IN GAMMA-IRRADIATED PYRIMIDINES. Benson, Brent Walter. University Park, Pa.; Pennsylvania State Univ. (1969). 93p.

Thesis.

Single crystals of five substituted pyrimidines were grown, irradiated, and analyzed by ESR techniques. These compounds are alloxan, alloxantin, 5-nitro-6-methyluracil, 5-nitrouracil, and 1,3-dimethyluracil. The free radical in alloxan is formed by cleavage of an OH from the five position, leaving the unpaired electron at C_5 coupling only to the proton of the remaining OH group. Hyperfine coupling principal values were determined to be +2.9, −5.9, and −7.2 gauss. Principal g-values are 2.0060, 2.0046, and 2.0022. Alloxantin, effectively a dimer of alloxan joined by a carbon–carbon covalent bond at the 5-position, yields the same free radicals on irradiation as alloxan due to the cleavage of the C−C bond. Hyperfine coupling principal values were determined to be +3.2, −5.8, and −7.3 gauss. Principal g-values are 2.0022, 2.0046, and 2.0059. Strong second order resonances were observed due to the simultaneous forbidden transitions of both the unpaired electron and the proton to which it is coupled. The free radical in 5-nitro-6-methyluracil is formed by hydrogen addition to the keto oxygen on C_4. The ESR spectra show coupling to this hydrogen and also to the methyl group at the 6-position. The spin densities were found to be 0.63 on C_4 and 0.32 on C_6. The principal g-values are 2.002, 2.005, and 2.008; the principal values for OH coupling are 9.5, −0.5, and −0.5 gauss; the principal values for CH_3 coupling are 10.7, 8.8, and 8.8 gauss. The free radical in 5-nitrouracil shows nitrogen coupling with principal values in gauss of 40.0, 25.2, 22.5 and principal g-values of 2.0117, 2.0064, 2.0027. The directions of these principal values show that the unpaired spin must be in an sp^2 orbital on either N_1 or the NO_2 nitrogen. The N_1 position seems the most probable. Hydrogen addition at C_6 of 1,3-dimethyluracil leaves a free radical on C_5. The unpaired electron on C_5 couples to one α-proton on C_5 and two inequivalent β-protons on C_6. A small amount of the similar 6-position radical formed by hydrogen addition at C_5 was also observed. This was identified by its coupling to the nitrogen at the 1-position. A summary of the features of radical formation is as follows. Free radicals are usually formed with the spin density at C_5. A NO_2 group at C_5 prevents this from being the site of the spin density, probably due to the extent of its π interaction with the ring π system. Methyl groups tend to direct the spin density to the carbon to which the methyl is bonded. Methyl groups are good sources of hydrogen atoms for the formation of hydrogen addition radicals. (Diss. Abstr.)

25072 NUCLEAR CONVERSION PROCESS. Westcott, Carl Henry (to Atomic Energy of Canada Ltd.). British Patent 1,187,188. 8 Apr 1970. Priority date 20 Mar 1968, United States.

A process for conversion of ^{232}Th into ^{233}U comprises irradiating a Th compound in a thermal neutron flux of 3 × 10^{15} to 7 × 10^{16} n/cm^2/sec for a period of 9 hr to 7 days to convert a substantial amount of the ^{232}Th into ^{233}Pa, removing the compound from the neutron flux, and cooling the compound for at least 5 mo to allow the ^{233}Pa to convert to ^{233}U by β decay. The final product is a Th compound containing at least 2% ^{233}U. (B.L.M.)

25073 NEW DETERMINATION OF STOICHIOMETRY OF THE IODOMETRIC METHOD FOR OZONE ANALYSIS AT pH 7.0. Boyd, A. William; Willis, Clive; Cyr, Ronald (Atomic Energy of Canada Ltd., Chalk River, Ont.). Anal. Chem.; 42: 670-2(May 1970).

Ozone yields from the pulse-electron radiolysis of oxygen were determined by an optical method as well as a method of oxidation of iodide in buffered solution and compared. The stoichiometry of the iodide method was examined at pH 7 and the concentration of ozone measured absolutely. The stoichiometry of the ozone–iodide reaction was found to be $1.5_3 \pm 0.1_2$ molecules of iodine liberated per molecule of ozone. (J.G.B.)

25074 COMPARISON OF CHEMICAL CHANGES IN POTATO TUBERS INDUCED BY γ-IRRADIATION AND BY CHEMICAL TREATMENT. Jaarma, Maire (Stockholm Univ.). Acta Chem. Scand.; 23: 3435-42(1969).

The contents of the free amino acids, γ-aminobutyric acid and glutamic acid, in potato tubers have been examined by paper chromatography. The changes in these two compounds induced in the tubers by γ irradiation and by treatment with the sprout-inhibitor CIPC (isopropyl-N-(3-chlorophenyl) carbamate) as compared with untreated tubers had been investigated. In parallel, the influence of both treatments on the saccharides, the total nitrogen, inorganic, acid labile, and total phosphorus has been analyzed. A comparison of effects caused by γ rays given with low-dose rate and with high-dose rate has been performed. The sprout-inhibiting effect of all three treatments has also been compared. (auth)

25075 RADIATION-CHEMICAL GRAFTING OF VINYLPYRIDINE TO POLY(VINYL ALCOHOL). Tashmukhamedov, S. A.; Karabaev, A. Sh.; Tillaev, R. S.; Usmanov, Kh. U. (Tashkent State Univ.). Uzb. Khim. Zh.; No. 4, 78-80(1969). (In Russian).

Graft copolymers were obtained by the simultaneous irradiation of a mixture of polymer and monomer in vacuum or in air. A ^{60}Co gamma source was used in the irradiations. At low doses little grafting occurred. The presence of methanol and water accelerated the grafting reaction. (tr-auth)

25076 PLUTONIUM-DOKUMENTATION. Referate-Zeitschrift mit Anhang Transplutonium-Elemente. Februar 1970. Band 4, Heft 2. 161 Referate (Register-Nr. 314-609). (Plutonium-Documentation. Abstract Journal with Appendix on Transplutonium Elements. February 1970. Vol. 4, No. 2. 161 Abstracts (Register No. 314-609). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung m.b.H. (1970). 96p. (In German and English).

25077 PLUTONIUM-DOKUMENTATION. Referate-Zeitschrift mit Anhang Transplutonium-Elemente. Maerz 1970. Band 4, Heft 3. 156 Referate (Register-No. 610-949). (Plutonium-Documentation. Abstract Journal with Appendix on Transplutonium Elements. March 1970. Vol. 4, No. 3. 156 Abstracts (Register No. 610-949). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung m.b.H. (1970). 119p. (In German and English).

25078 STUDIES OF THE RADIOLYSIS OF SOME ALLYLIC MONOMERS IN THE SOLID STATE BY MEANS OF ESR. Dakin, V. I.; Karpov, V. L. (Inst. of Physics and Chemistry, Moscow). Vysokomol. Soedin., Ser. A; 12: 409-15(Feb 1970). (In Russian).

Radical products of radiolysis at 100°K of some mono- and polyfunctional allylic monomers of the ester type, differing in the central part of the molecule, were studied. Radiolysis of the monomers gives rise to the allyl radical, $CH_2=CH-CH_2$, except for monomers in which the central part of the molecule is aromatic. Increases in temperature bring about accumulation of the allyl radical $CH_2=CH-CH-O-$. Primary allyl radicals result from dissociative capture of slow electron with the ester group and the secondary radicals from hydrogen atom abstraction from the allyl group in the monomer. (auth)

25079 STUDIES ON SOLUBILITY AND SORPTION PROPERTIES OF RARE EARTH METAL PHOSPHATES AND ASPECTS OF THEIR APPLICATION AS THE TARGET MATERIAL IN SYNCHROCYCLOTRON BOMBARDMENTS. Pfrepper, G. (Institut fuer Angewandte Radioaktivitaet, Leipzig); Pfrepper, R. Kernenergie; 13: 58-62(Feb 1970). (In German)

The appropriateness of aqueous suspensions of rare earth metal phosphates as the target material in synchrocyclotron bombardments was studied. Solubility products of $CePO_4$, $DyPO_4$, and $YbPO_4$ found by using a tracer technique amount to $(1.13 \pm 0.36) \times 10^{-24}$, $(3.6 \pm 1.3) \times 10^{-23}$, and $(8.2 \pm 1.2) \times 10^{-23}$, respectively. Sorption tests with microamounts of ^{144}Ce(III) showed that rare earth phosphates possess ion-exchange properties that are not lost even during heating up to 800°C. Sorption of Ce(III) decreases with decreasing HCl concentration of the external solution. When rare earth phosphates in suspension with 0.28 N HCl are bombarded with 660-MeV protons, 16.4 to 43.7 per cent of the rare earth nuclei formed change into aqueous phase in the various preparations. For annealed phosphates, enrichment factors of the rare earth isotopes were found to be smaller than 5.7×10^3 and, thus, more favorable than those obtained in bombarding rare earth phthalocyanine and DTPA complexes. Above all, CeO_2 seemed to be fit as the target material because of its low solubility in acids and its low sorption capacity. (auth)

25080 DETERMINATION OF RADIOLYSIS PRODUCTS OF AMINO ACIDS BY MASS SPECTROMETRY. Clark, Jim; Kushelevsky, A. P.; Slifkin, M. A. (Univ. of Salford, Eng.). Radiat. Eff.; 2: 303-4(Mar 1970).

Differences in the mass spectra of irradiated and unirradiated glycine are given and their significance discussed. Samples were exposed to ^{60}Co γ radiation ranging from 50 to 300 Mrads. The presence of acetic acid in the irradiated samples was proved. (M.C.G.)

25081 ISOTOPIC MIXING IN OO'-DIDEUTEROSUCCINIC ACID SINGLE CRYSTALS. Ericson, L. G.; Cutten, D. R. (Univ. of Adelaide). Mol. Cryst. Liquid Cryst.; 6: 273-85(Oct 1969).

Extensive isotopic mixing in partially deuterated succinic acid single crystals brought about by moderate doses of ionizing radiation point to a radiochemical reaction occurring with very large G value and thus to a free radical chain reaction. The isotopic mixing is evident in the ESR spectrum of the free radicals produced in low concentration and also, remarkably, in the ir absorption spectrum which reveals that a considerable fraction of all of the molecules in the crystal are involved. The evidence points to the possibility that hydrogen atom vacancies in organic crystals may sometimes be mobile, and so constitute a unique type of crystal defect. (auth)

25082 RADIOLYSIS IN NAPHTHALENE SINGLE CRYSTALS. Okubo, Takenori (Nagoya Univ., Japan); Itoh, Noriaki; Suita, Tokuo. Mol. Cryst. Liquid Cryst.; 6: 227-46(Oct 1969).

Experimental studies of optical absorption and electron paramagnetic resonance of naphthalene single crystals irradiated at liquid nitrogen, dry ice, and room temperatures were made. It was found that the EPR spectrum associated with the 1-hydronaphthyl radical was produced at all temperatures studied. Optical absorption bands at 337, 395, and 530 nm were thought to be associated with the 1-hydronaphthyl radical. Irradiation at liquid nitrogen temperature produced a broad doublet EPR spectrum as well as that associated with the 1-hydronaphthyl radical; the former is considered to be caused by the naphthyl radical. Irradiation at dry ice and room temperature produced optical absorption bands which are associated neither with the hydronaphthyl nor the naphthyl radical. It is suggested that the radiation products at higher temperature are the hydronaphthyl radical and the naphthalene dimer which is formed as the result of reaction of the naphthyl radical with a neighboring molecule. (auth)

25083 RADIOLYSIS OF LIQUID BENZENE-TETRACHLOROMETHANE MIXTURES BY ^{60}Co γ-RAYS. I. PRODUCTS OF RADIOLYSIS AND THEIR MATERIAL BALANCE. Schweiner, Z.; Bednar, J. (Nuclear Research Inst., Rez, Czech.). Radiochem. Radioanal. Lett.; 3: 263-71(24 Apr 1970).

In the γ radiolysis of benzene–tetrachloromethane mixtures hydrogen chloride, hexachloroethane, monochlorobenzene, benzotrichloride, and polymer were formed as main products. The material balance of radiolysis has been found satisfactory. (auth)

25084 RADIOLYSIS OF LIQUID BENZENE-TETRACHLOROMETHANE MIXTURES BY ^{60}Co γ-RAYS. II. REACTIONS OF EXCITED MOLECULES AT LOW BENZENE CONCENTRATIONS. Schweiner, Z.; Bednar, J. (Nuclear Research Inst., Rez. Czech.). Radiochem. Radioanal. Lett.; 3: 273-9(24 Apr 1970).

From the results of γ-radiolysis studies on benzene–carbon tetrachloride it is suggested that with low benzene concentrations the products are formed partly by direct decomposition of carbon tetrachloride, partly via singlet and triplet excited molecules of benzene, ionization of benzene adding very little to the total decomposition. (auth)

25085 PRIMARY YIELD OF HYDRAZINE IN THE RADIOLYSIS OF LIQUID AMMONIA. Belloni, J. (Laboratoire Curie, Paris). Radiochem. Radioanal. Lett.; 3: 305-12(24 Apr 1970). (In French).

From studies of the γ radiolysis of alkali metal–ammonia solutions, the primary molecular yield of hydrazine, due to NH_2 dimerization, was concluded to be $G_{N_2H_4} = 0.30$. In the absence of an effective NH scavenger, the N_2H_4 yield was increased owing to the reaction $NH + NH_3 \rightarrow N_2H_4$. The yield of NH was found to be $G_{NH} = 0.34$. (auth)

25086 RADIOLYSIS OF SOLUTIONS OF SILVER AND OF COPPER PERCHLORATE IN LIQUID AMMONIA. Jove, J. (Laboratoire Curie, Paris). Radiochem. Radioanal. Lett.; 3: 313-19(24 Apr 1970). (In French).

The γ radiolysis of dilute solutions of $AgClO_4$ and $Cu(ClO_4)_2$ in liquid ammonia has been investigated. Various yields were measured and values for primary yields are reported. $G_{H_2} = 0.70 G_{N_2H_4} = 0.65$, $G_{NH_2} - G_{red} = 0.10$. These values are discussed. (auth)

25087 REACTIONS OF GASES WITH IRRADIATED ORGANIC SOLIDS. IV. REACTIONS OF PROPIONAMIDE, n-BUTYRAMIDE, ISOBUTYRAMIDE, VALERAMIDE, AND STEARAMIDE WITH ETHYLENE. Perotti, A.; Faucitano, A.; Adler, G. (Brookhaven National Lab., Upton, N. Y.). Mol. Cryst. Liquid Cryst.; 6: 161-74(Oct 1969).

The reactions of γ-irradiated propionamide, n-butyramide, isobutyramide, valeramide, or stearamide with ethylene were studied by ESR spectroscopy, gas absorption, and x-ray diffraction. Some degree of polymerization of the ethylene apparently occurs in these systems. The results are discussed. (auth)

25088 ESR STUDIES ON GAMMA-IRRADIATED $(KPO_3)_n$ CRYSTALS. Hukuda, Kenzi; Nakahara, Motohiro; Kusumoto, Naoshi (Kyushu Univ., Fukuoka). J. Polym. Sci., Part A-2; 8: 447-53(Mar 1970).

Two types of $(KPO_3)_n$ crystals have been obtained: transparent crystals and semitransparent crystals that grew in the neighborhood of the wall of the crucible. In the latter type of crystals, four kinds of radicals, denoted B, C, D, and E, are observed by ESR measurements at 77°K on crystals irradiated with γ rays at the same temperature. The probable structure of B, C, and D radicals is concluded to be $-O-PO_2-O-$ from their g values and hyperfine constants (the superscript circle indicates a hole trapped in the radical). When these crystals are heated to room temperature, the ESR spectra of B, C, and D radicals disappear and the spectrum of another radical appears. This radical, designated A, has the possible structure $-O-PO_2$. The assumption that B radicals thermally decompose into A radicals is confirmed by experiment. With the transparent crystals, C, D, and E radicals are observed at low temperature, but only E radicals are stable at room temperature. The structure of the E radical is thought to be $-O-PO_2 \overset{\circ}{-} PO_2-O-$. (auth)

25089 CHEMICAL EFFECTS INDUCED BY NEUTRON IRRADIATION OF SODIUM TETRAMETAPHOSPHATE AS STUDIED BY PAPER ELECTROPHORESIS. Jovanovic-Kovacevic, O. Z. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). pp 95-102 of Chromatographie Electrophorese. Bruxelles; Presses Academiques Europeennes (1969).

From 5th International Symposium on Chromatography and Electrophoresis, Brussels, Belgium. See CONF-680971.

The chemical behavior of recoil ^{32}P in neutron-irradiated and thermally treated sodium tetrametaphosphate was investigated. After irradiation in the reactor resp. after subsequent thermal treatment samples were dissolved in water and analysed by use of high-voltage paper electrophoresis. About nine ^{32}P-labeled anions of oxyphosphorus acids were separated and identified. A relatively low percentage of ^{32}P activity in the initial form and in the reduced chemical forms was found. (auth)

25090 APPLICATION OF RADIATION POLYMERIZATION FOR THE PRODUCTION OF WATER-INSOLUBLE ENZYME PREPARATIONS. Dobo, J. (Plastics Research Inst., Budapest). Acta Chim. Acad. Sci. Hung.; 63: 453-6(1970).

Experiments on the entrapping of liophylized trypsin onto x-radiopolymerized acrylamide and bisacrylamide gels are reported. The activity was determined by a casein digestion method through comparison with the activity of pure trypsin. (J.G.B.)

Radiochemistry

Refer also to abstract 25060.

25091 (CEA-R-3949) SIMPLIFIED INSTALLATION FOR THE PREPARATION OF RADIOACTIVE COLLOIDAL GOLD. Carre, Roland; Falconi, Nicole (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Mar 1970. 10p. (In French). Dep. CFSTI (U. S. Sales Only).

An investigation was undertaken in order to find a simpler method of preparation of colloidal ^{198}Au without changing its quality. In the past, the equipment consisted of a large fixed device resulting in a very complicated system of circuits under vacuum and decreased pressure. The equipment described is a mobile unit composed of ordinary glassware such as beakers and erlenmeyers producing solutions of radioactive colloidal gold with usual characteristics. (France)

25092 EFFECTS OF PHASE HOMOGENEITY ON THE CHEMICAL CONSEQUENCES OF THE ISOMERIC TRANSITION IN ORGANIC SYSTEMS CONTAINING BROMINE. II. Grillet, S.; Mauguin, M.; Milman, M. (Commissariat a l'Energie Atomique de Saclay, Gif-sur-Yvette, France). Radiochem. Radioanal. Lett.; 3: 321-9(24 Apr 1970).

A study of the isomeric transition reaction $^{80m}Br \rightarrow {}^{80}Br$ taking place in solid mixtures of $CH_2BrCH_2Br + {}^{80m}Br_2$, $CH_2Br_2 + {}^{80m}Br_2$, $C_6H_6 + {}^{80m}Br_2$ showed undoubtedly that there is some relation between their radiochemical behavior and their phase diagram. (auth)

25093 PYROLYTIC METHOD FOR THE DIGESTION OF HIGHLY RADIOACTIVE GRAPHITE SAMPLES. Kiessling, S. (Kernforschungsanlage, Juelich, Ger.); Stoeppler, M. Z. Anal. Chem.; 249: 293-5(19 Mar 1970). (In German).

A new method for the rapid oxidizing digestion of highly radioactive graphite pellets, charcoal, and coated particles in oxygen at about 1000°C is described. Digestion is carried out in a simple remote handling quartz-apparatus in a lead cell. The sample ash is dissolved for strontium determination in HF/HCl or other acid mixtures. The over-all yield was found to be at least 99%. (auth)

Separation Processes

Refer also to abstracts 25076, 25077, 25093, 25218, 25221, 26775, and 26790.

25094 (AHSB(RP)R-101) DISPOSAL OF NOBLE GAS FISSION PRODUCTS FROM THE REPROCESSING OF NUCLEAR FUEL. Dunster, H. J. (United Kingdom Atomic Energy Authority, Harwell (England). Authority Health and Safety Branch); Warner, B. F. (United Kingdom Atomic Energy Authority, Sellafield (England). Production Group). Jan 1970. 30p. (CONF-691039-1). Dep. CFSTI (U. S. Sales Only). UK 5s.

From Meeting on Noble Gas Fission Products in the Nuclear Industry, Paris, France.

The radiological effects, local, national, and worldwide, of the release of ^{85}Kr from reprocessing plants are considered in relation to a UK national power programme and predictions of the world growth of nuclear power. The status of the UK work on ^{85}Kr removal and storage is reviewed and extrapolated to the programmes predicted to the year 2000. The review confirmed earlier UK assessments that national and worldwide radiation doses will not pose any significant problems until well into the 21st century, by which time the annual genetic dose from ^{85}Kr will probably be approaching 1% of the natural background dose rate of 10^{-1} rads/yr. It is demonstrated that there is good ground for confidence in the ability to extract the noble gases from the gaseous effluent from reprocessing plants when the need arises, and for the belief that the long-term storage of the ^{85}Kr will not pose insuperable technical problems. (auth) (UK)

25095 (BNWL-1311) FIXATION OF RADIOACTIVE RESIDUES. Research and Development Activities Quarterly Progress Report, November 1969-January 1970. Blasewitz, A. G. (ed.) (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Feb 1970. Contract AT(45-1)-1830. 54p. Dep. CFSTI.

Twenty-seven radioactive demonstrations in WSEP were completed with simulated wastes containing approximately 41 MCi of mixed radionuclides being converted to solids. The eleventh and final phosphate glass demonstration run in WSEP was completed. An LMFBR waste that simulated core fuel only (100,000 MWd/ton at 200 MW/ton) and that was aged 1.5 yrs was successfully processed to produce a solidified waste having a heat rate density of 196 W/l. Problems were encountered with a newly installed screw feeder (for delivering feed to the melter) and with alignment of the melt stream necessary to give an unimpaired entry into the receiver pot. During the eleven phosphate glass runs, a total of 19.3 MCi of radioactivity was interfused into 630 liters of solidified product. A fast reactor waste flowsheet operable in the spray solidifier was developed. Substitution of aluminum for 20% of the iron and addition of 20% excess rare earths to the waste did not appreciably affect the melt viscosity or feed flow stability. A study was initiated to determine the effects of recycling secondary waste streams (recovered acid and water) from solidification to a fuel reprocessing plant where the waste streams can be used as makeup water and acid for dissolution and first solvent extraction cycles. The relative volatilities of antimony, selenium, tellurium, and tin from LMFBR wastes were determined for the phosphate glass and spray solidification processes. Antimony and tin were not volatile. About 5% of the tellurium and 50% of the selenium were found in the phosphate glass melter condensate, and about 30% of the selenium was found in the spray solidifier condensate. Exposure of the waste container from Pot Calcination Demonstration Run PC-6 was begun in the Solids Storage Engineering Test Facility in air and at a maximum temperature of 600°C. Regression analysis of spray solidification product thermal conductivity data revealed that a value of 1.2 $W/(m^2)$ (°C/m) can be used as a value for effective thermal conductivity (k_{eff}) over the temperature range 100 to 600°C. Corresponding work showed that for phosphate glass product, k_{eff}, $[(W/(m^2)(°C/m)]$ equals $0.719 + 6.630 \times 10^{-4}t$, where t (°C) is the average product temperature. (auth)

25096 (DOCKET-50201-33) WEST VALLEY REPROCESSING PLANT. Quarterly Report, January 1-March 31, 1970. (Nuclear Fuel Services, Inc., West Valley, N. Y.). 20 Apr 1970. 12p. Dep. CFSTI.

Processing of Indian Point-1 lot XVI continued. Disposition of nuclear material in fuel at the plant is reported. Waste processing and disposal and environmental monitoring are discussed. (M.C.G.)

25097 (DOCKET-50332-11) BARNWELL NUCLEAR FUEL PLANT. Plutonium Product Loadout Hood. (Allied-Gulf Nuclear Services, Florham Park, N. J.). [nd]. 7p. Dep. CFSTI.

Conceptual sketches of the plutonium loadout facility for transferring plutonium-bearing material from storage vessels to shipping containers are given. (M.C.G.)

25098 (DP-1204) PREDICTED PERFORMANCE OF GS PROCESS WITH SUPPLEMENTARY FEED TO THE HOT TOWER. Burgess, Mitchell P. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Apr 1970. Contract AT(07-2)-1. 29p. Dep. CFSTI.

Calculations predict that a 10 to 11% increase in heavy water production can be achieved by adding a second water feed stream to the GS process first stage. The second feed stream would be pumped to that tray in the first stage hot tower where the heavy water concentrations of the feed and process liquors nearly match. Design criteria for selecting secondary feed rates and the feed tray were developed to guide a proposed plant evaluation. The calculations were made with a mathematical model of the heavy water processes programmed for the IBM System/360-65 computer. (auth)

25099 (JUL-627-RB) APPARATUS AND SOLVENT FOR RELEASING FISSION PRODUCT GAS FROM NUCLEAR FUELS. Kiessling, Siegfried; Stoeppler, Markus (Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorbauelemente). Dec 1969. 25p. (In German). Dep. CFSTI (U. S. Sales Only).

Two versions of a remote-handling quartz or duran-apparatus for the dissolution of irradiated nuclear fuel samples consisting of UO_2 pellets and coated particles are described. With the aid of specially purified helium the released fission gases are transported to and adsorbed at a cooled filter. This is followed by determination by γ spectrometry or mass spectrometry. Some acid mixtures for dissolution of the described materials are compared and the results are discussed. (auth)

25100 SIMPLE ION EXCHANGE SEPARATION OF MAGNESIUM FROM CALCIUM AND OTHER METAL IONS USING ETHYLENEGLYCOL-BIS(2-AMINOETHYLETHER) TETRAACETIC ACID AS A COMPLEXING AGENT. Marhol, Milan; Cheng, K. L. (Univ. of Missouri, Kansas City). Anal. Chem.; 42: 652-5(May 1970).

The calculated conditional stability constants at pH 2 to 10 for the ethyleneglycol-bis(2-aminoethylether)-tetraacetic acid (EGTA), indexed as [ethylenebis(oxyethylenenitrilo)]tetraacetic acid, complexes of calcium, magnesium, and other metals indicate that no significant amount of magnesium is complexed by EGTA at pH below 7. The distribution coefficients for magnesium, calcium, and strontium ions in an EGTA solution at various pH values were estimated on Dowex 50 W-X8, Chelex 100, and Amberlite IRC-50 in sodium form and on Dowex 1-X8 in chloride form. Magnesium can be selectively adsorbed on cation exchangers from an EGTA solution at pH 6.5 to 7.0 while calcium and many other metal ions form negatively charged EGTA complexes which are not adsorbed under these conditions. Satisfactory results are reported for recovering known amounts of magnesium from synthetic seawater mixtures. (auth)

25101 PROCESS AND APPARATUS FOR THE SEMICONTINUOUS DISSOLUTION OF SPENT NUCLEAR REACTOR FUEL. (to Allied Chemical Corp.). British Patent 1,187,369. 8 Apr 1970. Priority date 2 Apr 1968, United States.

A dissolver unit for spent reactor fuels with control of off-gas evolution comprises a main housing member open at one end and having an inlet for dissolving fluid at the opposite end. A recycle housing member open at one end is connected to the open end of the main housing member with the opposite end of the recycle housing member connected to the opposite end of the main housing member. The dissolving fluid is circulated through the main housing member and recycle housing, and the dissolved fuel solution is withdrawn from the housing. A heat exchanger is provided along a portion of the main housing. A semicontinuous process is also described for using the apparatus for fuel reprocessing. (B.L.M.)

25102 METHOD AND DEVICE FOR RECOVERING TELLURIUM FROM SCRAP. Beckert, Wolfgang; Ringel, Lilli; Kraev, Nikolai. German Patent 68,225. 5 Aug 1969. Filed 21 Jun 1968.

Known methods entail evaporation losses of Te and result in intermediate products that make the process uneconomical. This method provides simple means for recovering Te selectively from cooling-element scrap by dissolving the tellurides in acid solution under Cl_2 gas. Te and its contamination components are converted into their chlorides, which, under Cl_2, form complexes that are soluble in HCl. Tellurium is then recovered by introducing SO_2 gas. (Selenium-Tellurium Abstr.)

25103 STUDIES ON THE FLUIDIZED BED CALCINATION OF RADIOACTIVE LIQUID WASTES. Fukumoto, Tsutomu (Hitachi Shipbuilding and Engineering Co. Ltd., Osaka); Maeda, Kenjiro; Matagi, Yoshihiko. J. Nucl. Sci. Technol. (Tokyo); 7: 137-44(Mar 1970).

Studies were carried out on the fluidized-bed conversion of high-level radioactive liquid wastes into compact granular solids and on their growth rate. A calciner of 4-inch diameter provided with a projecting beak two-fluid atomizing nozzle was used with ferric sulfate solution as feed. The total weight of fluidized bed, as well as the rates of product withdrawal from the overflow pipe and of solid elutriation in the off-gas, was nearly constant throughout a run. The main source of the solids elutriated in the off-gas is considered to be contributed by solidification through drying and calcination of the spray droplets while suspended without depositing on bed particle surface. A convenient equation was obtained, which permits prediction of the growth rate of particles in a fluidized-bed calcination process with a reasonable degree of accuracy. (auth)

25104 SYNERGISM IN EXTRACTION CHROMATOGRAPHY. I. SEPARATION OF EUROPIUM FROM SAMARIUM. Aly, H. F.; El-Haggan, M. A. (Atomic Energy Establishment, Cairo). Radiochem. Radioanal. Lett.; 3: 249-53(24 Apr 1970).

The finding of synergism in the separation of Eu from Sm by extraction chromatography using TTA–N,N-dibutyldiethylcarbamyl phosphonate mixture is reported. It is noted that the synergistic enhancement in the distribution is accompanied by the reversal in the distribution sequence of the adjacent lanthanide investigated, as well as by the increase in the separation factor. (P.C.H.)

25105 EXTRACTION OF THORIUM(IV) FROM SULPHURIC ACID SOLUTIONS BY LONG-CHAIN ALIPHATIC AMINES. Sato, Taichi (Shizuoka Univ., Hamamatsu, Japan). J. Inorg. Nucl. Chem.; 32: 1341-9(Apr 1970).

The partition of thorium (IV) between aqueous sulphuric acid solutions and organic solutions of long-chain aliphatic amines was investigated. The organic phases were examined by ir and high resolution nuclear magnetic resonance spectroscopy. The effects of amine structure and the mechanism of thorium extraction are discussed. The amines studied were: di-n-octylamine (DOA), tri-n-octylamine (TOA), tri-n-dodecylamine (TDA) and tris-(2-ethyl hexyl) amine (TEHA). (auth) (UK)

25106 CHROMATOGRAPHIE ELECTROPHORESE. International Symposium V, Bruxelles, 16–18 Septembre 1968. (Chromatography and Electrophoresis. 5th International Symposium, Brussels, September 16–18, 1968). Bruxelles; Presses Academiques Europeennes (1969). 596p. (In several languages). (CONF-680971).

Separate abstracts were prepared for ten papers presented at the conference. Additional papers were presented on gas chromatography of steroids, improved methods for loading high-temperature gas-chromatographic columns, paper electrophoresis in combination with polarography, relation between the structure of organic compounds and their retention time in gas chromatography, and gas chromatographic studies involving charge-transfer interaction with the stationary phase. (H.L.W.)

For abstracts of individual papers see: 25002, 25064, 25089, 25107–25110, 25287, 25288, and 25379.

25107 THIN-LAYER CHROMATOGRAPHY IN INORGANIC ANALYSIS. Merkus, F. W. H. M. (R. C. Hospital, Sittard, Netherlands). pp 72-84 of Chromatographie Electrophorese. Bruxelles; Presses Academiques Europeennes (1969).

From 5th International Symposium on Chromatography and Electrophoresis, Brussels, Belgium. See CONF-680971.

The use of thin-layer chromatography (TLC) in inorganic analysis is reviewed. Thin-layer and paper chromatograms are compared. Results are given for the separation of the following cations by TLC on cellulose: Ag, Pb, and Tl; Cu, Cd, Bi, Pb, and Hg; As, Sb, and Sn; Fe, Al, Cr, Be, and UO_2; Co, Ni, Mn, and Zn; Ba, Ca, Sr, and Mg; and, Na, K, and Li. (J.G.B.)

25108 A STUDY OF OXALATES AS STATIONARY PHASES FOR ADSORPTION CHROMATOGRAPHY OF INORGANIC IONS. Massart, D. L. (Inst. for Nuclear Sciences, Ghent). pp 85-90 of Chromatographie Electrophorese. Bruxelles; Presses Academiques Europeennes (1969).

From 5th International Symposium on Chromatography and Electrophoresis, Brussels, Belgium. See CONF-680971.

The mechanism of the sorption of Eu on cadmium oxalate was studied. Eu is sorbed by precipitation on stoichiometric cadmium oxalate at sufficiently high Eu concentrations and at low concentrations on cadmium oxalate prepared with an excess of Cd ions through exchange of Cd^{2+} ions with Eu^{3+} ions. A few practical implications of this mechanism on chromatographic behavior are discussed. The sorption of other rare earths on Cd oxalate was also examined. (auth)

25109 SYNERGISM IN THE REVERSED-PHASE PARTITION CHROMATOGRAPHY OF URANIUM AND THORIUM. Cvjeticanin, N. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). pp 186-96 of Chromatographie Electrophorese. Bruxelles; Presses Academiques Europeennes (1969).

From 5th International Symposium on Chromatography and Electrophoresis, Brussels, Belgium. See CONF-680971.

Previously reported investigations on the behavior of ^{241}Am(III), Ce(III) and La(III) on paper treated with a mixture of thenoyltrifluoroacetone (HTTA), indexed as 4,4,4-trifluoro-1-(2-thienyl)-1,3-butanedione and tri-n-octyl phosphate (TOP) have shown that the retention of these ions is higher than if each extractant is used separately. The synergistic effect of the mixture of HTTA and TOP was investigated for U(VI) and Th(IV) by reversed-phase partition chromatography. The composition of the metallic species was determined by correlating log (1/Rf−1) with the amount of HTTA and TOP fixed on the paper and with the activity of the hydrogen ion in the mobile phase. $UO_2(TTA)_2TOP$ and $ThCl(TTA)_3TOP$ were formed under the investigated conditions. Conditions for the separation of uranium from thorium and their mutual separation from some tervalent lanthanides are also given. (auth)

25110 A REVIEW ON THE CHROMATOGRAPHY AND ELECTROPHORESIS ON THE PAPERS IMPREGNATED WITH THE INORGANIC ION EXCHANGERS. Qureshi, Mohsin (Aligarh Muslim Univ., India). pp 197-203 of Chromatographie Electrophorese. Bruxelles; Presses Academiques Europeennes (1969).

From 5th International Symposium on Chromatography and Electrophoresis, Brussels, Belgium. See CONF-680971.

A comparative study of the chromatographic behavior of 50 metal ions on papers impregnated with stannic tungstate, stannic molybdate, titanium tungstate, and titanium molybdate in three solvent systems is presented. (J.G.B.)

EARTH SCIENCES

Geology and Hydrology

Refer also to abstracts 25127, 25145, 25264, 25328, 25435, 25436, and 25473.

25111 (A-AC–82/G/L-1305) THE EFFECT OF SALTS ON ^{90}Sr ADSORPTION BY SOILS. Prokhorov, V. M.; Frid, A. S.; Ryzhinskii, M. V. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). 1968. 13p. (In Russian). Dep. CFSTI (U. S. Sales Only).

Different kinds of soil (chernozem, podzolic, etc.) were ground and sieved, and then contacted with a ^{90}Sr solution or with distilled water to give the soil a moisture content of 42 wt %. The soil was allowed to contact the tracer solution for 40 to 54 days in order to attain equilibrium. The soil was separated from the solution by centrifugation, and allowed to stand for two weeks before counting in order to attain equilibrium between ^{90}Sr and its daughter ^{90}Y. Salt solutions of $MgCl_2-Mg_2SO_4$, $NaCl-Na_2SO_4$, $Mg(NO_3)_2$, and EDTA were used at various concentrations. High salt concentrations tended to displace ^{90}Sr from the soil. However in the presence of sulfate, ^{90}Sr could be carried down by insoluble alkaline earth precipitates to give anomalous results. EDTA tends to complex ^{90}Sr from the soil, especially if the soil is wet with water and not with a concentrated salt solution. An electrophoretic experiment showed that the strontium was in the form of positive ions. (TTT)

25112 (USGS–474-66) GRAVITY SURVEY OF THE Ue15j SITE, AREA 15, NYE COUNTY, NEVADA. Healey, Don L. (Geological Survey, Denver, Colo.). 1970. Contract AT(29-2)-474. 14p. (NTS–223). Dep. CFSTI.

Interpretation of gravity data along three lines through the Ue15j site indicates the presence of an inferred major normal fault about 400 feet east of a fault mapped on the ground surface where a quartzite ridge crops out. The interpretation indicates that there is 1,200 to 1,300 feet of vertical displacement on the mapped fault. The configuration of the quartzite ridge is well defined by the gravity anomaly, and the interpretation shows a structural high to the west of the ridge where the gravity data define a gravity-high nose. (auth)

25113 RETENTION OF STRONTIUM BY SOILS AS INFLUENCED BY PH, ORGANIC MATTER, AND SATURATION CATIONS. Juo, Anthony S. R.; Barber, Stanley A. (Purdue Univ., Lafayette, Ind.). Soil Sci.; 109: 143-8(Mar 1970).

Four soils varying greatly in organic matter content, CEC and texture were selected for study. The effects of pH and the kind of saturation cations on the sorption and retention of Sr from a 3×10^{-3} $\underline{M}$ $SrCl_2$ solution labeled with ^{89}Sr were evaluated in terms of equilibrium distribution coefficient, Kd, and by repeated $\underline{N}$ NH_4Cl extraction. It was found that the sorption of Sr by soils increased with the increase of pH of the system, within the pH range studied (pH 4 to 8). The influence of the kind of saturation cations on the sorption of Sr by soils followed the order of $Na > K > Mg > Ca > Ba > H$. An increasing proportion of the sorbed Sr remained nonexchangeable with NH_4^+ as a result of increasing the pH of the system. This was attributed to the organic fraction of the soil. This portion of Sr may be permanently fixed by the soil under favorable pH conditions. It was also found that when an organic soil was brought into a higher pH environment, a significant portion of the Sr in the solution phase of the soil may be present as soluble Sr-chelates or complexes rather than as free Sr^{2+} ions. However, under normal pH conditions usually found in natural organic soils (pH about 5), the presence of soluble Sr-chelates or complexes in the soil solution should be negligible. (auth)

25114 AN EVALUATION OF THE URANIUM–HELIUM METHOD OF DATING OF FOSSIL BONES. Turekian, K. K. (Yale Univ., New Haven); Kharkar, D. P.; Funkhouser, J.; Schaeffer, O. A. Earth Planet Sci. Lett.; 7: 420-4(Feb 1970).

From a study of 6 bones of Oligocene age from different sites of one locality (the Fayum beds of Egypt) and 3 bones of Pleistocene or Pliocene age it is concluded that the general applicability of uranium–helium method of dating is not possible for fossil bones or other apatite deposits. The major problem appears to be continuous helium loss rather than recent uranium gain. (auth)

25115 URANIUM-SERIES AGES OF CORALS FROM THE RED SEA. Veeh, H. H. (Australian National Univ., Canberra); Giegengack, R. Nature (London); 226: 155-6(11 Apr 1970).

Age determinations by the $^{230}Th/^{234}U$ method are reported for corals from a Pleistocene littoral sequence along the Red Sea coast of Egypt, and are compared with previous attempts to date the reefs from other materials. The results confirmed the accuracy of earlier ^{230}Th determinations. The ages are based on an assumed initial $^{234}U/^{238}U$ ratio of about 1.15 at the time when the corals were living. An age of about 90,000 yr BP is proposed for a time when the relative sea level stood 10m higher than it does at present along the west coast of the Red Sea. (UK)

25116 APPLICATION AND SIGNIFICANCE OF ISOTOPE GEOCHEMISTRY. Roesler, Hans-Juergen; Pilot, Joachim. Z. Angew. Geol.; 15: 491-500(1969). (In German).

The abundance of isotopes is taken as a basic value in isotope geochemistry. The abundances are not constant for a number of elements, but vary under certain conditions due to nuclear processes and isotopic effects during geologic processes. Isotope geochemistry must determine and interpret the isotopic abundances of geologic bodies and their characteristics. There are important practical possibilities if the isotope abundances are related to time and temperature (radiometric age determinations and determinations of maximum and minimum temperatures of formation). Examples show that isotope geochemical studies can be made in practically all parts of the Earth; this field, with remarkable results already achieved, is still only at the beginning of its development. (auth)

25117 AN EXPERIMENTAL METHOD FOR DETERMINING THE TOTAL BETA–GAMMA SOIL RADIOACTIVITY. Szabo, A. Stiint. Solului; 6: No. 4, 23-7(1968). (In Rumanian).

A rapid and simple method for measuring total beta–gamma radioactivity in soil is described. By calibration curves, total radioactivity may be easily expressed in potassium percentage equivalents, ^{226}Ra percentage equivalents, in the overall β, γ activity (p Ci/g). The measurements can be made quickly without the samples being weighed previously. The method described may also be applied on a large scale for the determination of the potassium ratio, or of other single radionuclides in the samples required for industrial or scientific purposes. (Rom. Sci. Abstr.)

25118 CONTENT OF RADIOACTIVE ELEMENTS IN THE EARTH'S MANTLE. Lyustikh, E. N. Bull. Volcanol.; 33: 335-40(1969).

The content of radioactive elements in the crust, mantle, and core can be related to the depth of differentiation which created the crust. If there is steady-state thermal convection throughout the mantle, the outer core, if iron, cannot be liquid for the temperature at the core boundary would be about 2,000°C. The following figures are considered most probable: age of the Earth, 4.5 billion years; initial temperature at core boundary, 700°C; K/U ratio in mantle, 9,000; depth of differentiation, 400 km; mean U content of the crust, 0.8 ppM, and 0.065 ppM in undifferentiated mantle and core; temperature at core boundary, 4,500°C; the core is silicate, at least the outer core, and if the inner core is of iron, it is solid. (Geophys. Abstr.)

25119 Rb–Sr AGES OF YOSHIMURAITE AND ASSOCIATED MINERALS FROM THE TAGUCHI MANGANESE MINE, CENTRAL JAPAN. Yamaguchi, Masaru; Hirowatari, Fumitoshi (Kyushu Univ., Fukuoka). Sci. Rep. Fac. Sci., Kyushu Univ., Geol.; 9: No. 1, 143-6(Mar 1969). (In Japanese).

The Taguchi mine, situated about fifty kilometers north of the Toyohashi City, Central Japan, mines a manganese ore deposit in the Ryoke metamorphic complex composed mainly of banded quartz gneiss, banded biotite gneiss, and coarse-grained massive quartzite with small amounts of basic rocks. The ore bodies, extending about eighty meters to the strike side and about three meters in maximum thickness, are composed of layers of various mineral assemblages generally conformable with the Ryoke metamorphic rocks. The hanging wall rock is banded biotite gneiss while the foot wall rock is coarse grained massive quartzite. Yoshimuraite, a barium, titanium, manganese silicate mineral containing more than 2 percent strontium, occurs in the quartz-potassium feldspar-yoshimuraite-richterite-manganophyllite-rhodonite gneissic rock near the boundary of the ore bodies of the hanging wall rock side. Yoshimuraite, rhodonite, and manganophyllite separated from this rock, and rhodonite and manganophyllite from potassium feldspar-manganophyllite-rhodonite gneissic rock, a transitional layer of yoshimuraite bearing rock to the hanging wall rock, were analyzed for rubidium and strontium by the isotopic dilution method. The yoshimuraite, rhodonite and manganophyllite give an isochron age of 71 ± 3 Myr with an initial strontium ratio $Sr(87/86)_0 = 0.7092 \pm 0.0006$ which equal to the ratio of $^{87/86}$Sr of yoshimuraite and rhodonite. The rhodonite and manganophyllite of the transitional zone give an isochron age of 80 ± 3 Myr with an initial strontium ratio $Sr(87/86)_0$ = 0.7084 ± 0.0007 which equal to the ratio of $^{87/86}Sr$ of rhodonite. The ages of the manganese minerals are close to the late stage of the Ryoke metamorphism and the intrusions of granodiorites around this region, the yoshimuraite bearing rock being slightly younger than the rocks of the transitional zone. It has been reported that a Ryoke biotite schist has a ratio $Sr(87/86)_0$ = 0.718 and granodiorites have a ratio $Sr(87/86)_0$ = 0.7075 (Ozima et al, 1967). At present, the low isotope ratios of $Sr(87/86)_0$ of the manganese minerals may be interpreted in either way: the manganese minerals are closely related to the intrusions of the granodiorites, or derived from some basic igneous rocks, or formed by the incorporation of both basic rocks and the intrusions of the granodiorites. (NSA of Japan)

25120 DEVELOPMENT OF UNDERGROUND WATER THROUGH FISSURES. Ochiai, Toshiro; Kawasaki, Hironao (Agricultural Engineering Research Station, Hiratsuka, Japan). J. Jap. Water Works Ass.; No. 414, 21-9(Mar 1969). (In Japanese).

The water supply in cities in mountainous areas in Japan is a major problem due to the shortage of both surface waters and reservoirs of underground water. Then the supply of underground water flowing in fissures becomes important. The development of radiometric methods, based on natural radioactivity and natural tritium measurements, for locating and determining the flow of fissure-contained underground water in the Atami area, Shizuoka Prefecture is described. Consideration is given to the hydrologic and geologic features in the Atami area, the location of underground water veins using natural radioactivity measurements, measurements of radon concentrations in underground water, the use of natural tritium measurements to estimate the age of the underground water flowing through fissures, and methods for estimating the amount of water intake. (NSA of Japan)

25121 ISOTOPIC COMPOSITION OF LEAD FROM OCEANIC ISLANDS. Oversby, Virginia M.; Gast, Paul W. (Columbia Univ., Palisades, N. Y.). J. Geophys. Res.; 75: 2097-14(10 Apr 1970).

Lead isotopic compositions were determined for recent volcanic rocks from the islands of Tristan da Cunha and St. Helena in the Atlantic Ocean by an analytical method that allowed correction of observed ratios to absolute ratios. Lead and uranium concentrations were also measured for all samples. The phonolitic rocks on St. Helena had 207/204 ratios that were similar within the group, but were very different from the 207/204 ratios of basaltic rocks on St. Helena. This difference in $^{207}Pb/^{204}Pb$ appeared to be due to original heterogeneity in the mantle U/Pb ratio. Within the phonolites, a clear linear trend with a slope corresponding to 1.8×10^9 years was found. The highly radiogenic leads from St. Helena phonolites were interpreted by a two-stage growth model, the second stage starting 1.8×10^9 years ago. There was an indication among the basalt samples of a similar two-stage history, the second stage starting at approximately the same time as for the phonolites. A three-stage model with fractionation events at 4.1×10^9 years was also considered for the St. Helena samples. Trachyandesites from the 1961 flow on Tristan da Cunha showed considerable variation in their lead isotopic composition. This variation indicated the presence of two lead components, one of which belonged to the original magma. The second component was inferred to have come from the walls of a magma chamber via the incorporation of xenocrysts into the magma. The distribution of lead isotopic compositions from oceanic islands was discussed on a global scale. There is evidence for original heterogeneity in U/Pb and Th/U ratios amounting to about 5%. The implications of several models that attempt to explain the observed distribution pattern are discussed. (auth)

25122 DISTRIBUTION OF HYDROGEN AND OXYGEN ISOTOPES IN SOME NATURAL SITES IN YUGOSLAVIA. Vukmirovic, Z. M.; Matic, M. D. (Boris Kidric Inst. of Nuclear Science, Vinca, Yugoslavia). Bull. Soc. Chim. Beograd; 33: 265-70(1968). (In Serbo-Croatian).

The relative distribution of isotopes in the waters of lakes and rivers, and the Adriatic Sea was determined densitometrically by using a high precision method (falling, drop method). It was found that the deuterium content of the greatest rivers was the same. As compared to rivers, lake waters had a higher deuterium content; the highest relative increase in the isotope content was found in a lake (Vransko Jezero) located near the sea. The deuterium and ^{18}O content in the Adriatic Sea was also found to be higher, the deuterium content increasing at a 100 m depth. Samples of crude oil were also examined for comparison; a decrease in the deuterium content, as compared to rivers, was found (4 to 6%). (auth)

25123 INVESTIGATION OF THE KARSTIFICATION OF A LIMESTONE REGION BY MEANS OF NUCLEAR PHYSICAL LOGGING. Vitalis, Gyoergy. Z. Angew. Geol.; 15: 430-3 (1969). (In German).

The results of gamma, gamma-gamma, and neutron-gamma logging in a karst region of Hungary (western Nagyszál Mountains near Vac) are presented. The values obtained are plotted on a map, in order to determine the regularities of the process of karst formation. (Geophys. Abstr.)

25124 USE OF SELECTIVE GAMMA-GAMMA LOGGING ON LIGNITE DEPOSITS. Bardovskii, V. Ya.; Utkin, V. I.; Malevich, A. R.; Malevich, A. A. Razved. Geofiz.; No. 30, 89-94(1968). (In Russian).

An attempt to use selective gamma–gamma logging on the New Dmitrov lignite deposit is described. The results demonstrate the possibilities of the method in detecting lignite seams in a borehole section. Diatomites, not detectable by a combination of apparent resistivity, gamma, and density logging, are shown on the selective gamma–gamma logs as carbonaceous-clayey shales. When local cavernosity is absent the ash content of the coal can be determined from the selective gamma–gamma logs with sufficient accuracy. (Geophys. Abstr.)

Meteorology

Refer also to abstracts 25028, 25481, and 25482.

25125 (ARLV-351-4) WEATHER PREDICTIONS AND SURFACE RADIATION ESTIMATES FOR THE RULISON EVENT. Final Report. Stout, Albert H.; White, Ray E.; Quinn, Virgil E. (Environmental Science Services Administration, Las Vegas, Nev. Air Resources Lab.). Jan 1970. Contract SF-54-351. 62p. (PNE-R-26). Dep. CFSTI.

The equipment and procedures used to measure the meteorological conditions near Project Rulison ground-zero prior to and on the day of the detonation are described. This information was coordinated with data from the National Meteorological Network. Estimates were made of the amount of radioactivity released to the atmosphere by the explosion and the effects of meteorological conditions on the transport of radioactive fallout. It is concluded from the D-day meteorological data presented that the winds would have transported any released radioactivity toward the predicted direction. (L.C.L.)

25126 (CEA-R-3918) STUDY OF THE FALLOUT OF ARTIFICIAL ^{55}Fe. APPLICATION TO THE EVALUATION OF THE FALLOUT OF NATURAL IRON OF STRATOSPHERIC ORIGIN. Hoang Chi Trach (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Feb 1970. 102p. (In French). Dep. CFSTI (U. S. Sales Only).

Thesis. Submitted to Univ. of Paris, Faculte des Sciences, France.

The fallout of the iron-55 is studied with a view to establish the world balance of this radioelement. The input of natural iron of stratospheric origin to the earth and the input through the atmosphere of natural iron to the oceans are calculated. Iron-55 is found to be essentially produced in nuclear explosions according to the $^{56}Fe(n, 2n)^{55}Fe$ reaction; the iron-55 fallout obeys a stratospheric pattern with a decay period between 9 and 11 months. This fallout is 3.5 times more important by surface unit and at the same latitude on the eastern part of the Northern Atlantic than over France. The world balance of the iron-55 fallout in the 1962 to 1965 period was established by comparison with the strontium-90 fallout. This balance amounts to approximately 50 megacuries for the iron-55 introduced into the atmosphere, 25.3 megacuries of which fell on the earth during this period. The input of natural iron of stratospheric origin to the earth and the input through the atmosphere of natural iron to the oceans were estimated respectively at 6×10^6 and 1.2×10^7 tons per year. This latter figure represents 13 to 38 per cent of the amount of iron incorporated annually with the pelagic sediments. (auth) (France)

25127 (CONF-680664) RADIOACTIVE ENVIRONMENTAL CONTAMINATION. Reports of the Conference of Polish–German Working Group on Territorial Radioactive Fallout, Warsaw, June 17, 1968. (Centralny Osrodek Pomiarow Skazen Promieniotworczych, Warsaw (Poland)). 1969. 145p. (In several languages).

Reports given at the German-Polish conference on environmental contamination by radioactive fallout, held June 17, 1968, in Warsaw are presented. Information is included on the radioactivity in the atmosphere over East Germany during 1967; the effects of meteorological conditions on radon in the atmosphere; radiation monitoring of plants and soils in East Germany during 1967; the control of radioactivity in East German surface waters in 1967; cesium uptake, distribution, and transport in fish ponds; ^{137}Cs and ^{90}Sr contamination of the East German environment in

1967; the ^{137}Cs, K, and ^{90}Sr content in foodstuffs in Poland during 1965 and 1966; the volatility of ^{137}Cs during the incineration of biological samples; and the use of ^{90}Sr as a tracer for studying an ^{90}Y extraction process. (L.C.L.)

25128 (SWRHL-75-r) AEROSOL PREPARATION, GENERATION, AND ASSESSMENT, PROJECT HARE. James, R. H.; McNelis, D. N.; Whittaker, E. L.; Kennedy, N. C. (Public Health Service, Las Vegas, Nev. Southwestern Radiological Health Lab.). Feb 1970. 22p. Dep. CFSTI.

Project Hare was the sixth in a series of experiments in which a radioactive contaminant was released under controlled conditions to simulate the passage of a nuclear event-related radioactive cloud. The history of the radionuclide from the nuclear event to a constituent of man's diet was studied as a function of the interrelated physical, chemical, and biological variables. The measurement of some of the physical and chemical parameters involved in the preparation, generation, and assessment of the aerosol is reported. A dry aerosol consisting of submicrometer diatomaceous earth particles tagged with 54.1 mCi of ^{131}I was released over two types of growing forage (alfalfa and Sudan) at the Nevada Test Site. The study area was instrumented with fallout planchets, glass slides, air samplers, cascade impactors, and meteorological equipment. The aerosol was air-carried over the study area and deposited with an average activity concentration of 1.25 μCi/m^2 on the Sudan and 1.43 μCi/m^2 on the alfalfa. The count median diameter of the aerosol was 0.6 μm which varied only slightly from one location to another. Average integrated air concentration and average deposition velocity were 87.5 μCi-sec/m^3 and 1.59 cm/sec, respectively. (auth)

25129 SEA SURFACE AS A SINK OF EMANATION PRODUCTS. Assaf, G.; Gat, J. R. (Weizmann Inst. of Science, Rehovoth, Israel). Earth Planet Sci. Lett.; 7: 385-8(Feb 1970).

The extent of equilibrium between radon-222 and its shortlived daughter products was measured in air over the Eastern Mediterranean Sea. The uptake of aerosols by the sea surface is estimated from this measurement. A measurable scavenging effect was found only under stormy conditions when wave heights exceed 3 m. Lead-212 concentrations in the surface air are consistent with these scavenging effects. (auth)

25130 COSMOGENIC RADIONUCLIDE PRODUCTION RATES IN THE ATMOSPHERE. Young, J. A.; Thomas, C. W.; Wogman, N. A.; Perkins, R. W. (Battelle Memorial Inst., Richland, Wash.). J. Geophys. Res.; 75: 2385-90(20 Apr 1970).

The cosmic-ray spallation of atmospheric argon produces a unique group of radionuclides with half-lives ranging from minutes to millions of years. Depending on their physical characteristics, these radionuclides may either become attached to the atmospheric aerosol and thus serve as a tracer of its subsequent behavior, or may behave as a gas and follow precisely the prevailing air motions. To provide a more precise basis for the use of the short-lived radionuclides as tracers of short-term atmospheric mixing and precipitation processes, the atmospheric concentrations of ^{38}Cl (37 min), ^{39}Cl (55 min), and ^{24}Na (15 hours) and some longer-lived radionuclides have been measured at altitudes through 19 km and over a considerable range of latitudes. The observed concentration gradients are described, and the apparent relative production rates are compared with theoretical calculations and with some cosmic-ray production rates in argon. (auth)

25131 VERTICAL DISTRIBUTION OF ^{222}Rn IN THE ATMOSPHERE AND ITS USE FOR STUDY OF EXCHANGE IN THE LOWER TROPOSPHERE. Birot, A.; Adroguer, B.; Fontan, J. (Univ., Toulouse). J. Geophys. Res.; 75: 2373-83(20 Apr 1970).

One can theoretically represent the diffusion of radon or any other atmospheric pollutant in the lower troposphere by the differential diffusion equation of the K theory. This equation was solved numerically. In this model it is possible to choose any form of the diffusivity profile and of the vertical wind profile. The boundary conditions and the initial conditions can be modified according to the problem under consideration (geometry and intensity of the source, deposition at the earth's surface in the case of aerosols). In particular, we have used this model to study the diffusion of radon from a plane infinite source, a half-plane source, and a line source. We have measured the concentrations of radon in the troposphere. The results have been interpreted by a meteorological analysis; for certain data, the numerical model has been utilized. (auth)

25132 TRANSFER OF ^{14}C AND TRITIUM FROM THE ATMOSPHERE TO THE OCEAN. Suess, H. E. (Univ. of California, San Diego, La Jolla). J. Geophys. Res.; 75: 2363-4(20 Apr 1970).

The mechanisms by which nuclear explosion-produced ^{14}C (incorporated in CO$_2$) and tritium are transferred to ocean water are presented. Items discussed include ^{14}C transfer from stratosphere to troposphere, to ocean surface waters, and to deep ocean reservoirs; tritium uptake by the ocean; residence time of CO$_2$ and tritium in the atmosphere; and rates of transfer. More observed data on bomb-produced ^{14}C and tritium in the various environmental reservoirs are necessary for a detailed analysis. (L.C.L.)

25133 OBSERVED DISTRIBUTION OF RADIOACTIVITY, OZONE, AND POTENTIAL VORTICITY ASSOCIATED WITH TROPOPAUSE FOLDING. Danielsen, E.; Bleck, R.; Shedlovsky, J.; Wartburg, A.; Haagenson, P.; Pollock, W. (National Center for Atmospheric Research, Boulder, Colo.). J. Geophys. Res.; 75: 2353-61(20 Apr 1970).

On April 25, 1969, four RB-57 aircraft were used to obtain simultaneous measurements of radioactivity and ozone in the lower stratosphere and upper troposphere where a folded tropopause structure was predicted. With numerous "point" samples of radioactivity and continuous measurements of ozone it was possible to show, for the first time, that the two tracers were positively correlated on both the macroscale and the mesoscale. The potential vorticity, obtained from computer-analyzed isentropic analyses of the standard radiosonde observations, had the same macroscale distribution as the radioactivity and ozone, but the widely separated radiosonde data are not sufficient to resolve the mesoscale structure unless there are large variations in the vertical derivatives of temperature and wind. (auth)

25134 TRITIUM CONTENT IN A FIRN CORE FROM ANTARCTICA. Ravoire, J. (CEN de Saclay, Gif-sur-Yvette, France); Lorius, C.; Robert, J.; Roth, E. J. Geophys. Res.; 75: 2331-5 (20 Apr 1970).

Tritium in a firn core from the coastal zone of Adélie Coast, Antarctica, has been determined by gas-counting after samples were enriched by thermal diffusion. Measurements have been made down to a depth of 10 meters, which corresponds to a water equivalent of 5.35 meters. Each sample represents about 15 cm of water equivalent. Mean annual snow accumulation has been determined by tritium fallout from nuclear tests of 1954 and by radioactive decay of natural tritium. The values found by fallout and by radioactive decay are, respectively, 21 and 20 g cm^{-2} yr^{-1}. The agreement with data obtained by other methods is very good. Mean natural tritium content at the time of precipitation is 11.3 tritium units (TU), which corresponds to a rate of precipitation of natural tritium of 0.5 tritium atom cm^{-2} sec^{-1}. Important fluctuations arise in the natural tritium content of precipitation. An attempt to correlate tritium precipitation and solar activity is made difficult by the irregularity of snow accumulation at the site of the core. (auth)

25135 DEUTERIUM IN HURRICANE FAITH 1966: PRELIMINARY RESULTS. Ehhalt, Dieter H. (National Center for Atmospheric Research, Boulder, Colo.); Oestlund, H. Goete. J. Geophys. Res.; 75: 2323-7(20 Apr 1970).

Simultaneous precipitation and water vapor samples from Hurricane Faith, August 28, and September 1, 1966, have been analyzed for their deuterium-to-hydrogen ratio. The radial distributions of the D/H isotope ratio have been obtained for the 600-, 1200-, 2100-, and 3000-meter altitude levels. In horizontal displays the D/H ratios of vapor and liquid show characteristic variations with deep minima near the inner and outer rainbands and higher values between. In vertical profiles the D/H ratios exhibit a decrease with altitude, which is much steeper within the rainbands than outside. In both cases the decrease exceeds the value predicted by Rayleigh condensation. The measurements also show that precipitation and cloud vapor are not in isotopic equilibrium, and that the deviation from equilibrium varies systematically across a rainband. The observed D distribution is explained qualitatively as being due to raindrops carried by upper level winds from the updraft towers to the high-pressure side of the rainband. (auth)

25136 HURRICANE TRITIUM III: EVAPORATION OF SEA WATER IN HURRICANE FAITH 1966. Oestlund, H. Goete (Univ. of Miami, Fla.). J. Geophys. Res.; 75: 2303-9(20 Apr 1970).

Radial distribution of fusion-bomb-produced tritium, as HTO, has been measured in the inflow layer of a hurricane, together with temperature, humidity, and wind data. The tritium values are used to determine the rate of evaporation of sea water within the storm envelope. In Faith, August 28, 1966, this evaporation amounted to 10% of the total water vapor budget inside 150-km radius. Radial distribution of evaporation rates and rainfall rates was obtained. Largest uncertainty in the results arises from the measurement of relative wind component. (auth)

25137 TRACING ATMOSPHERIC EDDY MASS TRANSFER BY MEANS OF NATURAL RADIOACTIVITY. Israel, H.; Horbert, M. (Technische Hochschule, Aachen). J. Geophys. Res.; 75: 2291-7(20 Apr 1970).

The vertical thoron-concentration profile in the atmosphere and, hence, the local turbulent mass transfer can be measured by means of recently developed mobile equipment. First examples of measurements of the eddy diffusivity are given and compared with the synchronous eddy viscosity. Radon and dust concentrations are related to the turbulent mass transfer. Moreover, some methods for determining the exhalation rate are presented, and the dependence of the exhalation rate on various meteorological parameters is discussed. (auth)

25138 SLOPE OF SURFACES OF MAXIMUM TRACER CONCENTRATION IN THE LOWER STRATOSPHERE. Machta, Lester; Telegadas, Kosta; List, Robert J. (Air Resources Labs., Silver Spring, Md.). J. Geophys. Res.; 75: 2279-89(20 Apr 1970).

The level of maximum concentration of radioactive tracer material injected into the stratosphere is invariably observed to slope from higher altitudes over the equator to lower altitudes and colder potential temperatures near the pole. Six months to a year after injections into the lower stratosphere in equatorial, temperate, and polar latitudes, the configurations of the levels of maximum concentration were almost identical irrespective of the source latitude and possible variations in initial altitude and vertical distribution. For the temperate latitude injection in the summer of 1967 there are sufficient data to examine the details of the genesis of the surface of maximum concentration. The data show a poleward movement of the center of concentration by midfall, a net descent in the late fall and winter poleward of 55°N and subsequent quasi-horizontal mixing the following spring and summer. Tracers originally injected into the upper stratosphere or mesosphere follow similar patterns, as does a tracer injected into the stratosphere of a computer-generated model of the general circulation. (auth)

25139 PROSPECTIVE DECREASE IN ATMOSPHERIC RADIOCARBON. Nydal, Reidar; Loevseth, Knut (Radiological Dating Lab., Trondheim, Norway). J. Geophys. Res.; 75: 2271-8(20 Apr 1970).

Since 1965 the excess of artificial ^{14}C in the troposphere has been decreasing. The ^{14}C that appears in the atmosphere as radioactive CO_2 disappears into the ocean and the terrestrial vegetation. Our calculation is based on a residence time for CO_2 in the atmosphere of 4 to 6 years. The exchange between the atmosphere and the mixed layer of the ocean occurs according to a residence time of 5 to 10 years. In the mixed layer of the ocean ^{14}C is removed much faster than was earlier expected. It is assumed that ^{14}C in this layer has reached its maximum level (10 to 15% above normal) and will decrease. With an assumed decrease according to a decrease coefficient of 0.1 to 0.05 year^{-1} in the mixed layer, the atmospheric ^{14}C level is calculated for further years according to a two-term exponential function. The calculation predicts that a normal ^{14}C level in the atmosphere will be reached in about 30 years. Further nuclear tests will, of course, change the predicted level. (auth)

25140 TRITIUM INJECTION AND CONCENTRATION DISTRIBUTION IN THE ATMOSPHERE. Schell, W. R.; Sauzay, G.; Payne, B. R. (IAEA, Vienna). J. Geophys. Res.; 75: 2251-66 (20 Apr 1970).

The use of environmental tritium as a water tracer has significantly increased our understanding of hydrological processes. Because of the large stratospheric reservoir of tritium produced by nuclear detonations and the relatively slow mixing rates between the stratosphere and the troposphere, studies of meteorological parameters of transport and diffusion can be made over many years. If the nuclear test ban treaty is observed and if no more large atmospheric nuclear detonations are conducted, the seasonal and annual changes in the atmospheric tritium distribution can give important information on the hydrological cycle and on meteorological effects. Stratospheric injection for a water tracer to the concentration of tracer in precipitation by means of meteorological parameters is discussed. A simplified model was developed that relates injection, exchange, evaporation, condensation of water vapor, and tritium to meteorological parameters in the troposphere. Since the form of the model is general, tritium, fallout radionuclide, deuterium, and oxygen-18 data can be used as tracers to test the basic assumptions and to examine the physical processes that are occurring. The model was tested with meteorological data and tritium concentrations in precipitation from the IAEA/WMO World Network of sampling stations. The results of the initial application of the model to western Europe are presented. (auth)

25141 TRITIUM CONTENT OF RAIN IN TRONDHEIM. Gulliksen, Steinar (Radiological Dating Lab., Trondheim, Norway). J. Geophys. Res.; 75: 2247-9(20 Apr 1970).

The tritium concentration of rain has decreased during recent years. Since 1967 precipitation samples have been collected in Trondheim. Monthly samples were analyzed for their tritium content by the proportional counting techniques. The average tritium concentration in 1967 was 190 TU, and the observations indicate an average for 1969 of 115 TU. The decrease corresponds to a stratospheric residence time of 3.4 years for tritium. (auth)

25142 STUDY ON PLUTONIUM FALLOUT. Miyake, Y.; Katsuragi, Y.; Sugimura, Y. (Meteorological Research Inst., Tokyo). J. Geophys. Res.; 75: 2329-30(20 Apr 1970).

Total depositions of $^{239,240}Pu$ and ^{238}Pu from 1958 to April 1969 are, respectively, 0.97 mCi/km^2 and 42 μCi/km^2 in Tokyo. The ratio of ^{238}Pu to $^{239,240}Pu$ increased in fallout remarkably since 1967. This increase is considered to be due to ^{238}Pu scattered from SNAP-9A generator in 1964. Surface values of plutonium isotopes of the Japan Sea ranged from 3.0 to 20.4 × 10^{-15} g/l (0.2 to 1.2 × 10^{-3} pCi/l) with the ratio of ^{238}Pu to $^{239,240}Pu$ ranging from 13.2 to 37.7%. We observed the deep penetration of these isotopes in the sea. (auth)

25143 NUCLEAR INDUSTRY AND AIR POLLUTION. Rivera-Cordero, Antonio (Drexel Univ., Philadelphia). Environ. Sci. Technol.; 4: 392-5(May 1970).

An understanding of the problem of air pollution by radioactive materials from the nuclear industry is assuming greater significance as the number and size of power reactors and their operation by private industry increases. Types of waste radioactivity (e.g., natural, fission-product, activation-product), in gaseous or dust form, from a variety of sources such as mining of U ores, fuel fabrication, fuel irradiation and processing, reactor operation, radioisotope applications, radioactive waste disposal, and peaceful uses of nuclear explosives, the amount of air pollution from these sources, and methods used to control and monitor radioactive air pollution are discussed. (L.C.L.)

25144 AMBIENT RADIOACTIVITY IN THE MEMBER STATES OF THE EUROPEAN ATOMIC ORGANIZATION. Witt, E. Zentralbl. Arbeitsmed. Arbeitsschutz; 18: 237-40(1968). (In German).

A network of measuring stations has been set up to monitor the atmospheric radioactivity in the member states of the European Atomic Community. The results of regular measurements are correlated by the Health Protection Commission as they come in and they are then examined, compared and evaluated. Two series of publications deal with them, one with radioactive contamination of the water and air and with fallout, and the other with radioactive contamination of food. According to these publications, the general trend has been for radioactive contamination of the atmosphere, water and food examined continually to diminish. The results are identical to those obtained in other parts of the Northern Hemisphere. The measurements have also shown that the radioactivity is almost entirely due to nuclear weapon tests. The development of the radioactivity in the atmosphere, the fallout and the milk is published quarterly so as to enable authorities concerned with contamination problems to be kept fully informed at more frequent intervals. A brief general survey of the subject is presented. (Excerpta Med.)

25145 ENVIRONMENTAL RADIOACTIVITY IN THE MEMBER STATES OF THE EUROPEAN ATOMIC UNION. Witt, E. Zentralb. Arbeitsmed. Arbeitsschutz; 18: 237-40(Aug 1968). (In German).

The member states of the European Atomic Community (E.A.C.) developed a system of stations for monitoring environmental radioactivity. Results of regular measurements are sent to the center for health protection of the E.A.G. where they are compared and evaluated. Finally, they are published in two reports: one concerns the radioactive contamination of water, air, and fallout; the second one deals with radioactive contamination of foodstuffs. A decrease in contamination was noted since the beginning of the test ban treaty. The findings closely parallel those obtained in Canada and the U. S. (H.B.G.)

25146 COSMOGENIC AND ARTIFICIAL ^{22}Na LEVELS IN RAINWATER. Cigna, A. A.; Clemente, G. F.; Giorcelli, F. G. (Comitato Nazionale per l'Energia Nucleare, Rome). Health Phys.; 18: 379-82(Apr 1970).

The results of a survey on the ^{22}Na concentration in rain water samples collected at the Casaccia Nuclear Center are here reported. Monthly measurements for the period 1962 to 1968 were performed by a gamma-gamma sum coincidence spectrometer. Both the artificial and cosmogenic components were evaluated. An average value of 18 μCi/km^2/yr was obtained as the best estimate of the natural component. The mean residence half time measured after the artificial component was 11.2 months. (auth) (UK)

25147 AN EMPIRICAL MODEL FOR ESTIMATING WORLD-WIDE DEPOSITION FROM ATMOSPHERIC NUCLEAR DETONATIONS. Peterson, Kendall R. (Air Resources Labs., Silver Spring, Md.). Health Phys.; 18: 357-78(Apr 1970).

An empirical model is presented for estimating the surface deposition of worldwide radioactivity from atmospheric nuclear detonations given the yield, latitude, season and type of each burst. The procedure is readily adaptable to computer calculation. The model is based primarily on injection-deposition experience gained from the U. S. and U.S.S.R. nuclear tests in 1958. Use of the technique to estimate ^{90}Sr deposition from the 1961−62 tests shows the predictions are usually within a factor of two of the observed deposition. (auth) (UK)

Mineralogy and Exploration

25148 (BNL-50187) WESTERN COAL DEPOSITS: A NATIONAL SOURCE OF POWER. Steinberg, M.; Powell, J.; Manowitz, B. (Brookhaven National Lab., Upton, N. Y.). Nov 1969. 28p. Dep. CFSTI.

The need, technology, and economics of a national energy system based on the vast western coal reserves are described. Large western-based MHD power generating plants feeding power to 50,000-MW(e) long distance cryogenic transmission lines could deliver pollution-free power to far western and eastern energy consuming load centers at 2.5 to 4 mills/kWh(e) total cost. The possibility of by-product uranium, hydrogen, heavy water, and communications could further increase the utility and economic value of the system. (auth)

25149 (RME-4107) URANIUM IN THE APPALACHIAN MOBILE BELT. Gabelman, John W. (Division of Raw Materials (AEC), Washington, D. C.). Mar 1968. 41p. GPO $0.50.

Distribution of epigenetic metal concentrations in the Appalachian mobile belt and continental foreland of North America exhibited linear metallogenic zones parallel to coincident tectonic tends. The zones define regional temperature-paragenetic gradients that decreased across the belt toward the foreland. Variation in metal families and ratios along the belt may reflect its passage through different metallogenic provinces. The gradients, representing mineralization cycles, can be correlated with tectonic gradients representing specific orogenic phases of two major tectonic cycles. The uranium occurrences comprise: a belt of plutonic alkalic intrusives containing economic high-temperature uranium-thorium concentrations parallel to and southeast of the Grenville front; small concentrations associated with amphibole-magnetite-sulfide replacements in high-temperature iron zones; uraninite veins in gold-copper zones; low-temperature copper-uranium impregnations in late Paleozoic and Triassic sandstone superimposed on high-temperature iron and copper zones in hinterland basins; and small uranium impregnations in Paleozoic sandstone at the low-temperature ends of mineralization gradients along the foreland margin. These uranium occurrences in orogenic-related mineralization cycles, with metallotectonic gradients generally similar to those in the Cordillera where uranium is most abundant at the low-temperature ends, indicate that uranium of Paleozoic or Mesozoic cycles in the Appalachian belt also may be most prominent in the lowest temperature metallotectonic zone along the foreland margin. Although this zone is not now known to contain significant deposits, it may be a good exploration target. (auth)

25150 URANIUM MINERALIZATION IN THE POKHRI TUNJI AREA CHAMOLI DISTRICT, GARHWAL. Negi, B. S. Quart. J. Geol., Mining Met. Soc. India; 39: 93-7(1967).

Study of a 15 sq. mile area around Pokhri and Tunji villages of Uttar Pradesh, revealed radioactivity of the order of 3 to more than 25 times background along the fault zones in the rocks, supposed to be equivalent to the Jaunsar Series. The rocks of this area seemed to represent an overturned isoclinal anticline, with faulting along the contact of the various rock formations. Groove samples from the trenches chemically assayed 0.017 to 0.3% U_3O_8 with less than 0.01% ThO_2. The material excavated from the shallow test pits and trenches assayed 0.05 to 0.31% U_3O_8 by stack logging methods. Two composite samples from the Pokhri and Tunji area chemically assayed 0.079 and 0.104% U_3O_8 respectively and less than 0.01% ThO_2. Tests on Tunji ore showed that up to 93% of the radioactivity values could be leached by nitric acid. Pitchblende and torbernite were identified in the radioactive rocks along with pyrite, chalcopyrite and galena. Uranium mineralization in this area seems to be related to the hydrothermal solution associated with the intrusion of the Central Gneiss. (Indian Sci. Abstr.)

Oceanography

Refer also to abstracts 25122 and 25129.

25151 SURPRISING RADIOACTIVE AMPULES (SOVIET SPECIALISTS BUILD SMALL NUCLEAR POWER STATIONS ANGARA AND EFIR). Gerasimov, G. Sots. Ind.; 3p.(23 Aug 1969). (In Russian).

The remote control loading of radioactive materials into tungsten capsules was demonstrated. The heat generated in the capsules is transferred to thermoelectric converters consisting of batteries of thermoelements. The energy is converted directly into electrical current. These devices are extremely reliable, have no moving parts, and can operate in almost any environment. They replace batteries for the operation of remote automatic hydrometeorological stations. The battery power supplies of a ten-watt station have to be reworked every 3 to 4 months, necessitating long helicopter flights or even long journeys on foot to remote places. The small, widely used isotopic thermoelectric generator Beta-C is a miniature nuclear power station, which can operate at least 10 years without maintenance. The newly developed Angara, in addition to producing electrical energy, can heat equipment installations in cold, damp climates. The Efir is designed to power radio beacons. Isotopic thermoelectric generators have been used in medicine as heart pacemakers. Such pacemakers are implanted and must be replaced every year or two. A miniature nuclear generator to power electronic pacemakers has been developed. The power supply is the size of a bead, fed by a plutonium isotope, and is capable of operating well over 10 years in complete safety of the patient from radiation. (JPRS)

ENGINEERING

Nuclear Explosions

Refer also to abstracts 25125, 25126, 25147, and 25329.

25152 (FOA-4-4402) THERMAL RADIATION FRONT FROM A POINT EXPLOSION. Hoernqvist, N. (Forsvarets Forskningsanstalt, Stockholm (Sweden)). Oct 1969. 21p. Dep. CFSTI (U. S. Sales Only).

The propagation of thermal radiation from a point explosion is considered, using the radiation diffusion approximation. The existence of a sharp forward boundary, representing a radiative front, is demonstrated by the exact solutions to the one-dimensional plane in cylindrical and spherical cases. (auth) (Sweden)

25153 (NCG-TR-19) THE NCG FALLOUT SCALING MODEL: A GRAPHIC-NUMERICAL METHOD OF PREDICTING FALLOUT PATTERNS FOR NUCLEAR CRATERING DETONATIONS. Burton, Donald E. (Army Engineer Nuclear Cratering Group, Livermore, Calif.). Jan 1970. 76p. Dep. CFSTI.

A scaling model was developed to predict the H + 1 hour exposure rate in the area contaminated by the radioactive fallout from an underground nuclear detonation fired at any depth of burst. Exposure rate predictions can be made within the base surge region in both the upwind and crosswind directions and in the downwind fallout pattern to a distance at which the 0.01 R/hr exposure contour would be experienced. These predictions can then be used to construct isoexposure-rate contour maps for feasibility studies. The model was developed by requiring the observed and predicted exposure rates for seven underground (Danny Boy, Teapot Ess, Cabriolet, Sedan, Schooner, Jangle U, and Buggy) and two surface (Jangle S and Johnie Boy) detonations to be consistent. The results indicate that predictions based on this model will be reliable to within a factor of 2 to 4. A significant result of this investigation was a method of the partitioning of activity between the base surge and the main cloud. (auth)

25154 (UCRL-50802) DESCRIPTION OF THE PUFL FORTRAN PROGRAM. Barr, Leota; Reed, Eleanor (California Univ., Livermore. Lawrence Radiation Lab.). 5 Jan 1970. 38p. Dep. CFSTI.

The PUFL code (Fortran program) performs a gasdynamic calculation for a pipe flow with entrainment. PUFL is used at LRL in the Plowshare program. PUFL consists of a large number of nested subroutines which help to separate the code into natural, distinct units of logical control or calculation. The numerous subroutines exist because usually each addition to PUFL was attached as a subroutine to the running program. PUFL has over 100 input variables all or part of which may be defined by the user. (auth)

25155 (UCRL-Trans-10441) SEISMICS AND CRATERS FORMED BY EXPLOSIONS IN UNDERGROUND BLASTS. Romashov, A. N.; Kharin, D. A. (eds.). Translated by J. Mulhaus for Univ. of California Lawrence Radiation Lab., Livermore, from Vzryvnoe Delo, Nauch.-Tekh. Gorn. Ubshchest., Sb.; No. 64/21, 3-261(1968). 238p. Dep. CFSTI.

The results of experimental and theoretical investigations in the field of underground explosions are presented. The major portion of the papers is devoted to the seismic effects of explosions. Much attention is given to explaining the nature of the separate waves making up the total wave train of the seismic vibrations. Data are presented characterizing the relation of the basic parameters of the waves of greatest intensity to the weight of the charge, the distances between the upper center and the point of observation, to the depth of placement of the charge and the apparatus, to the type of soil, and to the conditions of setting up the apparatus, and others. A number of the papers deal with investigations into the movement of the medium in direct proximity to the explosion center. It is shown that explosions near the free surface are not simple centers of the expansion. Heaving of the medium in the epicenter zone of the explosion plays an important role in the process of wave emission. Explanation of the character of the wave source is of great significance in analyzing the methods of controlling wave energies when conducting multiple industrial explosions. Several questions are examined on interaction of the separate charges in multiple explosions as well as numerous questions of procedure, such as making observations, reading oscillograms, handling materials, and others. The basic problems examined concerning the results of cratering studies are: explanation of the mechanism of the formation of the apparent crater; explanation of the criteria of similitude of craters for explosions of various magnitudes; and special features of the development of cratering explosions for large charges with weights on the order of 1,000 tons. The results of an analysis of laboratory and field investigations, including some data on underground nuclear explosions, and methods of modeling cratering explosion phenomena are included. The problems of development of explosions in unbounded mediums (underground explosions) are also examined. The results of the measurement and computations of the basic parameters of underground explosions are examined. The influence of the properties of the medium on the basic parameters of underground explosions was analyzed. The papers are arranged in order of the development of the explosive phenomena itself. First materials are presented about the underground explosion, showing the initial stage of development of any explosion, then material about the crater formation, and finally material about the seismology of underground explosions. (115 references). (auth)

25156 ENGINEERING WITH NUCLEAR EXPLOSIVES. Parker, K. (Atomic Weapons Research Establishment, Aldermaston, Eng.). New Sci.; 46: No. 695, 9-11(2 Apr 1970).

The role of nuclear explosive engineering, which is shifting from earth moving explosions of the cratering type to completely contained explosions aimed at increasing the efficiency of the exploitation of fuels and minerals, is discussed. In particular, oil storage, gas storage, oil stimulation, gas stimulation, energy storage, and waste disposal are examined as possible uses near populated areas. (UK)

25157 NUCLEAR EXPLOSIVES MAY FIND USE IN STIMULATING GEOTHERMAL ENERGY. Power; 114: No. 5, 71(May 1970).

The possibility of using underground nuclear explosions to create cavities in hot (300 to 500°C) underground (6000 to 10,000 ft deep) rock into which water could be added to produce steam for driving turbine generators is discussed briefly. (L.C.L.)

Facilities and Equipment

Refer also to abstracts 25232, 25263, 25369, 25665, 25679, 26125, 26129, 26554, 26812, 26848, and 26849.

25158 (AERE-R-6343) THE HARWELL SPUTTERED ION GUN. Hill, K. J.; Nelson, R. S.; Francis, R. J. (Atomic Energy Research Establishment, Harwell (England)). Mar 1970. 16p. Dep. CFSTI (U. S. Sales Only). UK 3s. 6d.

An ion source is described, which produces ion beams of any element without the requirement of a furnace. The Sputtered Ion Gun is adaptable to different techniques which suit specific source materials. It is particularly useful in obtaining ions of platinum, iridium, palladium and gold, and its use in the sputtering mode ensures the absence of unwanted compounds which may cause contamination. Various modes of operation are described, the characteristics and some typical yields of the gun are given. Use in conjunction with an electrostatic lens, the ion beam may be readily focused to a 1 mm diameter spot. (auth) (UK)

25159 (BNL-50145) TABULATED DOSE UNIFORMITY RATIO AND MINIMUM DOSE DATA FOR GAMMA IRRADIATOR DESIGN. Rizzo, F. X.; Galanter, L.; Krishnamurthy, K. (Brookhaven National Lab., Upton, N. Y.). Apr 1969. 122p. Dep. CFSTI.

Dose uniformity ratio and minimum dose data in cobalt-60 and cesium-137 rectangular source irradiators are presented in tables. Dose distribution tabular data are in this way supplied to the irradiator designer, allowing quick approximation of the performance of most gamma irradiators which utilize rectangular sources and targets. The data should find its greatest use in performing estimates for plant and product feasibility studies, cost estimates, and for preliminary design calculations. (J.R.D.)

25160 (BNL-50147) TABULATED DOSE DISTRIBUTION DATA FOR GAMMA IRRADIATOR DESIGN. Rizzo, F. X.; Galanter, L.; Krishnamurthy, K. (Brookhaven National Lab., Upton, N. Y.). Apr 1969. 66p. Dep. CFSTI.

Data are tabulated which make available to the designer of package irradiators the dose distribution information necessary to perform quick, easy, and reasonably accurate calculations of the dose distribution characteristics of irradiators when using either cobalt-60 or cesium-137 plaque sources. The data should find its greatest use in performing dose distribution calculations necessary for plant and product feasibility studies, cost estimates for bid purposes, and for most preliminary design calculations. Those who are especially knowledgeable in the fields of radiation physics and irradiator design will find that these data, when properly operated upon, can be put to an even wider range of usefulness. The data presented in the tables are the depth dose distributions in semi-infinite homogeneous media over a range of target densities from both cobalt-60 and cesium-137 source plaques of various sizes. These targets were assumed to be bounded only at the front surfaces, by the source, air gap, and the absorbers. (J.R.D.)

25161 (BNWL-1269) MIXING MOCK-UP STUDY OF THE SODIUM CHEMICAL TECHNOLOGY FACILITY SODIUM RESERVOIR. Lester, D. H.; Smith, W. F. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Mar 1970. Contract AT(45-1)-1830. 39p. Dep. CFSTI.

The possibility of using free jets to agitate 1200°F liquid sodium in a 1500 gal tank was investigated. Tracer tests were made in a 54 gal water model of the jet mixing tank using jets 0.26 to 0.38 in. diameters and flow rates from 4.4 to 8.8 gal/min. The impulse response of the tank was measured at the outlet and various internal points. Acceptable agitation over a wide range of flow rates was obtained. (auth)

25162 (EUR-4463) DESCRIPTION OF THE BETULLA INSTALLATION. Gollinelli, P.; Holtbecker, H.; Montagnani, M. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). 6 Nov 1969. 44p. Dep. CFSTI (U. S. Sales Only). EUR FF 6.65.

A detailed description of a plant constructed for reactor safety studies is presented. Essentially this installation consists of a high pressure (50 bars), high temperature (450°C) and high volume (5 m^3) circuit and a low pressure (15 bars) and temperature (200°C) water circuit, which are connected to a 12 m^3 tank. The present test section and the dynamic measuring instrumentation placed in an explosion resistant bunker are explained. (auth)

25163 (TID-4100(Suppl.57)) ENGINEERING MATERIALS LIST. Smith, Richard J.; Sachs, Francis L.; Clark, Willie E. (eds.) (Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). Apr 1970. 40p. Dep. CFSTI.

Twenty-three packages of engineering drawings and specifications are presented for: 12-inch fast gate valve; proportional water samplers; isokinetic probe; thermoluminescent tissue equivalent dosimeter; ATR primary coolant system 20-inch check valve; chassis assemblies for rack mounting; infrared displacement transducer; short-term tensile tester; passive accelerometer systems; automatic volumetric flow system; eddy-current angular displacement measuring system; standard FLOGIC cards; uranium colorimeter; refrigerated liquid hydrogen target system; opto-electronic feedback preamplifier; spark chamber reader system; data link transmission system, ICIOB terminator; thermal neutron survey meter; derivative computer for thermogravimetric analysis; biaxial stress testing system; and whole-body-counter pallet drive. A subject index is included. (J.C.W.)

25164 (UCRL-50007-69-3, pp 17-19) DESCRIPTION AND USE OF THE NEW WALK-IN DECONTAMINATION HOOD. Volk, E. E.; Kvam, D. J. (California Univ., Livermore. Lawrence Radiation Lab.).

A description of the new walk-in hood for radiation hazards control at the decontamination facility is given. The main purposes of the hood is to collect contaminated water and solvent mixtures which collect as a result of steam cleaning and to trap hazardous vapors. (W.H.K.)

25165 (UCRL-72060) EFFECT OF MAGNETIC FIELDS ON HEAT PIPES. Carlson, Gustav A.; Hoffman, Myron A. (California Univ., Livermore. Lawrence Radiation Lab.). 31 Dec 1969. 30p. (CONF-700604-1). Dep. CFSTI.

From ASME Space Technology and Heat Transfer Conference, Los Angeles, Calif.

Heat pipes have been proposed for use in environments where there are strong magnetic fields such as in controlled fusion reactors. The presence of a magnetic field can influence the performance of a heat pipe significantly, depending on the heat pipe geometry, its orientation in the magnetic field, the heat pipe materials and fluid properties as well as the magnetic field strength. A liquid-metal heat pipe, specifically designed to operate in a magnetic field, will employ a compound wick structure with the optimum liquid flow passage size larger and the vapor flow passage proportionately smaller than for the no-magnetic-field design. The basic conclusion is that the presence of a magnetic field always results in a lower maximum heat flux capability, but the detrimental effects of the magnetic field can be greatly reduced by using a heat pipe geometry optimized for operation in the specific magnetic field environment. (auth)

25166 USE OF PNEUMATIC SYSTEM FOR DISPLACING RADIATION SOURCE IN GAMMA-RADIOGRAPHY MACHINES. Hlebowicz, J. (Electrotechnical Research Inst., Warsaw). Pomiary, Automat., Kontr.; 15: 275-7(1969). (In Polish).

Pneumatic systems incorporated in gamma-radiography machines of considerable reach of the radiation source are described, and a review is presented of more interesting domestic and foreign designs, including the general trends of development of these machines with the pneumatic system. (auth) (NSA of Poland)

25167 IMPROVEMENTS RELATING TO STEAM GENERATORS. Morris, James Peter; Jenkinson, John Norman (to United Kingdom Atomic Energy Authority). British Patent 1,184,792. 18 Mar 1970. Filed 22 Jun 1966.

Reference is made to B.P. 1,130,391 in which is described a liquid metal heated steam generator consisting of steam generation tubes which describe a path of U configuration in a shell through which the liquid metal flows, and tube plates of inlet and outlet headers forming part of the wall of the shell at its upper or head end. This combination of features brings the inlet and outlet headers very close together. It is desirable that the headers should be readily demountable to enable quick access to the tube plates for stopping-off defective tubes, this being particularly important if the two fluids involved react, such as with liquid sodium. In the improved system described in the present specification the steam generator is characterised by at least one of the headers having a header cavity and a tube plate with apertures opening into the cavity. A cover is provided for the cavity, together with a non-screwed mechanical fastening for securing the cover on the shell wall and sealing means between the cover and the shell wall. This avoids the difficulty likely to arise on account of the close proximity of the inlet and outlet headers, of providing in the more conventional screwed fastening, such as that using flanges, a sufficient amount of bolt or stud strength for high header pressures. A non-screwed fastening should also be more quickly releasable. At least one of the headers may be annular, with an annular header cavity and an annular cover, and the mechanical fastening may include a shear ring located in opposed annular grooves in the inner and outer edges of the cover and shell wall. The cover may also have a cavity located so as to be in registration with the header cavity in its secured position. The cavities may together form a header space of circular cross-section. The sealing means may comprise an annular gasket, with a backing ring located in a trough formed by registering annular steps in opposed faces of the cover and shell wall, together with means for applying compression to the backing ring and thence to the gasket. (UK)

25168 DEVICE FOR PRODUCING A LIQUID HAVING RADIOACTIVE CONSTITUENTS. (to Philips' Gloeilampen-Fabrieken). British Patent 1,186,587. 2 Apr 1970. Priority date 3 Jun 1966, Netherlands.

The design is given of a device for producing a liquid having radioactive components. There are two receptacles. The solid radioactive material is introduced into one of the receptacles. By quick-coupling means, the material is washed into a solution containing daughter-substances of the radioactive material suitable for radiation therapy for injection into the human body. (J.C.W.)

25169 CONTINUOUS SAMPLER MONITOR (CMS) (10 Sep 1969) (Engineering Materials). (Idaho Nuclear Corp., Idaho Falls). (CAPE-1985).
6 drawings.

The sampler-monitor, which determines airborne noble gas, total iodine, organic iodine, and total fission product concentrations in containment building atmosphere, is capable of rapid response to changes in containment atmosphere activity. The apparatus includes a scrubber which continuously samples airborne fission products and separates them into a liquid stream, leaving Kr, Xe, and organic iodides in the gas stream. After leaving the containment building, the liquid and gas streams are separated, monitored individually for gross activity levels, and sampled to determine isotopic concentration. The scrubber will wash particles larger than 0.2 μ in dia into the liquid stream. Total iodine concentration agrees to within 10% of values determined by particulate iodide samplers. In the case of airborne methyliodide, values in the gas stream were ~½ the actual value; the balance is absorbed by the basic thiosulfate scrubbing agent. As reagent temperature increases absorption of methyl iodide increases. Ethyl iodide is less soluble in the reagent and is more accurately determined in the gas phase. Also described are caves for an ion chamber and a G-M counter. The caves are fabricated of lead bricks. (F.S.)

25170 SODIUM LEVEL INDICATOR (7 Apr 1969) (Engineering Materials). (Argonne National Lab., Ill.). (CAPE-1986).
6 drawings.

A Na level indicator, which has a measuring range of 20 in.

with an accuracy of ±¼ in., employs the principle that the force measured by a transducer is equal to the weight (mass) of a cylinder minus the weight (mass) of Na it displaces. Components of the system are: a level transmitter that includes a stainless steel buoyancy cylinder, a force transducer, and a stainless steel bellows that serves as a gas seal; an amplifier; modulator; trip circuits; and a level indicator. The force transducer has a linearity of 0.2%, a repeatability of 0.1%, and a minimum zero shift due to temperature changes of 0.02%/°F. The transducer consists of a differential transformer with a movable core which travels 0.005 in. for a full load of 5%, a support rod, and a buoyancy cylinder. The amplifier provides a 4 mA output for an input of 24 mV. The output drives the alarm switches of the indicator. The modulator provides a 1650 Hz signal to the differential transformer and detects the output signal from the transformer. The modulator sends an output current of up to 1 mA to a 1500 Ω load resistor. The transducer-modulator has a sensitivity of 6 mV/lb as measured across the 1500 Ω load resistor. The trip circuits are part of a reactor shutdown circuit and are set to trip at ±3 in. from the normal Na level. (For details see TID-4100 Suppl. 58) (See also 24: 13588). (F.S.)

25171 RADIATION CONTROL DESIGN FOR A CONVERTED 400 kVp X-RAY THERAPY MACHINE. Irwin, Carl W.; Ware, George W. (Univ. of Arizona, Tucson). Health Phys.; 18: 415-16(Apr 1970).

The conversion of a 400 kVp x-ray therapy machine to a high-level irradiator was reported earlier (Ware, G. W, Kwin, C. K., J. Econ. Entomal. 62: 721(1969)). The calculations for and installation of shielding facilities are discussed and the design of the irradiation device described. Results of a survey around the facility are given. (UK)

25172 STRUCTURAL ANALYSIS OF SHELL INTERSECTIONS. Prince, N.; Rashid, Y. R. (Gulf General Atomic Inc., San Diego, Calif.). pp 245-54 of Pressure Vessel Technology. Pt. I. New York; American Society of Mechanical Engineers (1969).

From 1st International Conference on Pressure Vessel Technology, Delft, Netherlands. See CONF-690906(Pt.1).

A finite-element analysis is presented for general, three-dimensional, elastic thin shells. The finite-element model used is a triangular plate element whose membrane and bending deformations are approximated by cubic polynomial functions. The shell surface is approximated by a network of such plate elements of arbitrary orientation, permitting the treatment of shells of arbitrary configurations and loading. The solution of the resulting large number of unknowns is briefly discussed. Comparisons with a simpler model and a known exact solution and with experimental data for a nozzle-to-cylinder intersection are presented. (auth)

25173 PRETIGHTENING OF LARGE PRESSURE-VESSEL FLANGE JOINTS. Kuchta, J.; Sneberger, J. (Skoda Works, Pilsen, Czech.). pp 477-90 of Pressure Vessel Technology. Pt. I. New York; American Society of Mechanical Engineers (1969).

From 1st International Conference on Pressure Vessel Technology, Delft, Netherlands. See CONF-690906(Pt.1).

Calculations, design of auxiliary devices, and certain experiments during the solution of the problem of pretightening a free-flange joint with 5,500-mm pitch diameter and 42 bolts with 200-mm thread diameter and 4,000-mm in length have been carried out. The angles of rotation of the nuts for the method of simultaneous pretightening of several bolts under the condition of equal final forces in all bolts were established. The bolts were stressed by means of three hydraulic jacks and, in other experiments, by means of thermal preheating. Pretightening and releasing of the bolts in the actual flange joint was checked by a detailed strain gauge measurement of each bolt. This experiment was repeated several times with mild rubber and also with metal sealing between the flanges. Measured values are compared to a theoretical solution. (auth)

25174 DEVELOPMENT OF LARGE PRESSURE VESSELS OF MULTILAYER STEEL CONSTRUCTION. Jorde, J.; Bretfeld, H.; Mueller, R.; Vierling, P. (Fried-Krupp GmbH, Essen). pp 501-11 of Pressure Vessel Technology. Pt. I. New York; American Society of Mechanical Engineers (1969).

From 1st International Conference on Pressure Vessel Technology, Delft, Netherlands. See CONF-690906(Pt.1).

The development, construction, and testing of pressure vessels of multilayer steel construction capable of being completely fabricated at the ultimate site from flat sheets or plates are described. It is anticipated that large-size vessels of this type will be used chiefly in nuclear-reactor engineering where their greater resistance to brittle fracture will be of particular importance. (auth)

25175 DEFORMATION OF LARGE-DIAMETER, HIGH-PRESSURE VESSEL FLANGES. van Campen, D. H.; Deen, P. J.; Latzko, D. G. H. (Univ. of Tech., Delft, Netherlands). pp 529-49 of Pressure Vessel Technology. Pt. I. New York; American Society of Mechanical Engineers (1969).

From 1st International Conference on Pressure Vessel Technology, Delft, Netherlands. See CONF-690906(Pt.1).

Analytical and experimental work is reported on the rotation of tapered hub flanges typical for large-diameter, high-pressure applications. Particular attention is given to the question of whether the hub should be treated as a ring with undeformable cross section or as a thin cylindrical shell of variable thickness. Information is presented on the plastic behavior of the metal-to-metal contact sealing faces and the resulting shift in the point of application of the gasket reaction. (auth)

25176 AN APPROACH TO DETECTING THE BRITTLE TRANSITION TEMPERATURE OF PRESSURE VESSEL STEELS BY HARDNESS TESTING. Sato, S. (Ibaraki Univ., Japan); Oku, T.; Yuhara, S.; Usui, T. pp 679-93 of Pressure Vessel Technology. Pt. II. New York; American Society of Mechanical Engineers (1969).

From 1st International Conference on Pressure Vessel Technology, Delft, Netherlands. See CONF-690906(Pt.2).

A nondestructive approach to measuring the brittle transition temperature of several pressure vessel steels by means of hardness testing at low temperatures is described. The transition temperature in such hardness tests is defined as the intersection of the two straight-line parts of the plot of the logarithmic Vickers hardness vs. the reciprocal of absolute temperature. The one or two intersection points were found to be in the range between room temperature and −196°C for the steels tested. The higher one is called the first discontinuity temperature, and the lower one the second discontinuity temperature. The temperature dependence of hardness was discussed in comparison with the results of the specially instrumented Charpy impact test and the usual tensile test. It was concluded that the first and second discontinuity temperatures were equivalent to the ductile transition temperature and brittle transition temperature, respectively. The approach has been tried as a surveillance measure of an increase of the nil ductility transition temperature due to neutron irradiation for reactor vessel steels. It has also been applied in the measurement of the brittle transition temperature distribution of welded steel plates. (auth)

25177 PREDICTION OF FAILURE IN PRESSURIZED VESSELS. Folias, E. S. (Univ. of Utah, Salt Lake City). pp 781-91 of Pressure Vessel Technology. Pt. II. New York; American Society of Mechanical Engineers (1969).

From 1st International Conference on Pressure Vessel Technology, Delft, Netherlands. See CONF-690906(Pt.2).

A fracture criterion for the prediction of failure in flawed pressurized vessels of arbitrary shape is discussed. A comparison with some of the existing experimental data in the literature substantiates its potential use. (auth)

25178 CYLINDRICAL, METAL PRESSURE BODIES MADE BY LIMITED EXPANSION OF THEIR WALLS WITH OR WITHOUT PRESTRESS. Denoor, G.; Tascher, C. (BVS Co., Grenoble, France). pp 877-93 of Pressure Vessel Technology. Pt. II. New York; American Society of Mechanical Engineers (1969).

From 1st International Conference on Pressure Vessel Technology, Delft, Netherlands. See CONF-690906(Pt.2).

The nuclear, petroleum, gas, chemical, and other industries are using vessels and pipelines of ever increasing capacities and ever higher pressures. The expansion of the cylindrical metal walls allows the construction of vessels and tubes of the multi-walled type or reinforced by prestress. Already achieved constructions are described and new types of units, together with a summary of their calculation theories, recent tests, photographs, and diagrams are presented. (auth)

25179 FABRICATION AND TESTING OF FULL-SIZE PRESSURE VESSEL MODEL. Amano, M.; Sliga, V.; Naiki, T. (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo). pp 929-50 of Pressure Vessel Technology. Pt. II. New York; American Society of Mechanical Engineers (1969).

From 1st International Conference on Pressure Vessel Technology, Delft, Netherlands. See CONF-690906(Pt.2).

In order to investigate the mechanical and chemical properties of fabricated vessel components and to determine the fabrication and inspection practices that would be employed for production, a full-size model of a reactor pressure vessel was fabricated and tested. The production of the model conformed to the practices of the ASME Boiler and Pressure Vessel Code, Section III, Nuclear Vessels and included every key stage of the fabrication of the reactor pressure vessel. With the experience gained in the test program, production procedures were developed, with these procedures implemented with a precise quality-control system. The fabrication of the first large-scale reactor pressure vessel produced by Ishikawajima-Harima Heavy Industries Co., Ltd. (IHI) is nearly complete without the occurrence of any serious production problems. (auth)

25180 SPECIFICATIONS FOR EQUIPMENT FOR USE IN HOT CELLS. Stradal, K. (Kernforschungsanlage GmbH, Juelich, Ger.). Kerntechnik; 12: 57-9(Feb 1970). (In German and English).

Instruments which are used for operation of hot cells have some basic specifications in common. Four of them are the most important and are briefly mentioned. (auth)

25181 CLASSIFICATION OF COMPONENTS AND EQUIPMENT OF HOT CELLS. Stradal, K. (Kernforschungsanlage GmbH, Juelich, Ger.). Kerntechnic; 12: 60(Feb 1970). (In German and English).

A highly limiting definition is given in order to fit the components of hot cells into a system. Also, a suggestion is made for a corresponding catalog. (auth)

25182 CHEMICAL AND PROCESS ENGINEERING RESEARCH TECHNIQUES IN HOT CELLS. Witte, H. (Kernforschungsanlage GmbH, Juelich, Ger.). Kerntechnik; 12: 61-7(Feb 1970). (In German and English).

Two different designs of hot cell facilities at the Jülich Nuclear Research Facility—the HZ 2 Laboratory and the chemical cells currently under construction—are compared in respect of their suitability for chemical and process engineering investigations. (auth)

25183 HOT CELLS FOR THE PROCESSING OF SOLID RADIOACTIVE WASTES. Koehler, W.; Engelmann, H. J. (Gesellschaft fuer Kernforschung mbH, Karlsruhe, Ger.). Kerntechnik; 12: 67-70(Feb 1970). (In German and English).

A new hot cell facility intended for use in reducing solid highly radioactive wastes into a form suitable for permanent storage, and for packaging and storing these wastes is described. This block of cells is the core of the FERAB facility of the Karlsruhe Nuclear Research Center. (auth)

25184 TWO NEW ELECTRIC POWER MANIPULATORS. Koehler, W.; Selig, M. (Gesellschaft fuer Kernforschung mbH, Karlsruhe, Ger.). Kerntechnik; 12: 71-4(Feb 1970). (In German and English).

Two heavy duty power manipulators are described, intended for use in the hot cells of the facility for processing solid radioactive wastes at the Karlsruhe Nuclear Research Center. One is a universal remotely controlled manipulator, the other is a special device for handling and stacking 200 liter drums. (auth)

25185 FACILITY FOR THE COMPLETE PROCESSING OF ACTINIDE TARGETS IN THE MULTI-Ci RANGE. Born, H. J.; Hoehlein, G.; Schuetz, B.; Specht, S.; Weinlaender, W. (Technische Hochschule, Munich). Kerntechnik; 12: 75-80(Feb 1970). (In German and English).

A facility for the chemical processing of highly active actinide targets has been installed, using equipment which had already been tested for separation of ^{242}Cm in the 1000 Ci range. With the aid of this facility it is possible to open irradiated capsules, to process and separate the radioactive materials, to convert these materials into a solid form, to encapsulate these solid materials and to weld the capsules. The flowsheet and the more important items of equipment of the chemistry cells are described. (auth)

25186 GLOVEBOX FOR COLUMN-CHROMATOGRAPHIC INVESTIGATIONS ON ACTINIDES. Hoehlein, G.; Specht, S.; Voeller, H.; Weinlaender, W. (Technische Hochschule, Munich). Kerntechnik; 12: 81-4(Feb 1970). (In German and English).

A glovebox fitted for column-chromatographic work on actinide elements and their fission products is described. Among the features discussed are certain special equipment details, the column operation techniques, the activity measurement techniques and devices, and the versatility of the facility. (auth)

25187 'CHIPLESS' DRILLING INTO NUCLEAR PIPING. Bosley, H. C. Power; 114: No. 5, 64(May 1970).

A "chip-free" method for putting holes for thermocouples through 2½ in.-thick walls of 30 in.-dia OD nuclear reactor coolant pipes is described. The method consists of: welding a thermocouple boss to the exterior of the pipe, determining the pipe thickness at the hole location by ultrasonic testing, drilling through the boss and pipe wall to within 0.025 in. of the pipe inner face and using an ultrasonic probe to check the hole button thickness, cleansing and drying the drilled hole, inserting a hollow insulating bushing in the hole so that a steel push rod can be spot welded to the area at the bottom of the hole only, knocking out the bottom of the hole with the push rod, and, finally, removing the push rod with knock-out button attached leaving the desired clean hole. (L.C.L.)

25188 DEVICE AFFORDING TOTAL BIOLOGICAL PROTECTION FOR IRRADIATION OF A FLUID CIRCULATING WITHIN A TUBE. Bost, Jose; Hollard, Daniel; Peccoud, Michel; Suscillon, Michel (to Commissariat a l'Energie Atomique). British Patent 1,187,580. 8 Apr 1970. Priority date 5 Apr 1968, France.

The design is given of an apparatus for biological shielding during the irradiation of a fluid such as blood while being circulated within a tube, both ends of which are connected to an examination apparatus. The tube to carry the fluid is wound on a ring. An irradiation source is then set in place for the irradiation. The apparatus is housed in a lead drum. (J.C.W.)

25189 IMPROVEMENTS IN AND RELATING TO WATER SEPARATORS FOR SATURATED-STEAM GENERATORS. (to Sulzer Brothers Ltd.). British Patent 1,189,253. 22 Apr 1970. Priority date 31 May 1967, Switzerland.

A design is given for water separators for saturated-steam generators suitable for use with nuclear reactor plants. A space-saving and economical separator is provided if the jackets are arranged with their axes in a hexagonal pattern and are connected to each other. (J.C.W.)

25190 IMPROVEMENTS IN AND RELATING TO A PLATE-AND -SHAFT ASSEMBLY FOR A UNIDIRECTIONAL ROTARY MACHINE. Taverne, Henri (to Commissariat a l'Energie Atomique). British Patent 1,186,824. 8 Apr 1970. Priority date 19 Jan 1967, France.

A design is given of a plate-and-shaft assembly for a unidirectional rotary machine to operate in a hot cell into which the samples are introduced by remote-control handling devices. The plate can be readily dismantled. The rotary device is used for polishing machines. (J.C.W.)

25191 IMPROVEMENTS IN OR RELATING TO HEAT-EXCHANGERS IN NUCLEAR POWER PLANT. (to Fives-Penhoet). British Patent 1,189,056. 22 Apr 1970. Priority date 15 Feb 1967, France.

A method is described for operating a nuclear power plant with an upright cylindrical vessel containing a reactor and a heat exchanger placed below or above the reactor. A method is given for correcting the temperature variations occurring in the heat conveying fluid. The tubes in the vessel are redistributed into groups such that at a given cross section the range of variation of the temperature within each group is a fraction of the range of variation over the whole cross section of the vessel. The flow control apparatus operates automatically in response to the temperature produced by the respective group of tubes. (J.C.W.)

25192 IRRADIATION APPARATUS. (to Sulzer Brothers Ltd.). British Patent 1,187,741. 15 Apr 1970. Priority date 3 May 1967, Switzerland.

The design of irradiation apparatus is given in which the material to be irradiated is carried in individual load carriers past a radiation source on a chain conveyor. The load carriers travel past the radiation source more than once on different tracks and the loads are close together on the conveyor. (J.C.W.)

25193 STEAM-LUBRICATED ROTOR-BEARING SYSTEM (11 Sep 1969)(Engineering Materials). (Mechanical Technology Inc., Latham, N. Y.). (CAPE-1994).
23 drawings.

An experimental rotor-bearing system, which is used with pressurized steam as the lubricant, was designed by modifying the system described in CAPE-1882. The rotor, which is made from one forging, is 58 in. long, weighs ~200 lbs, and is supported by two externally pressurized, steam-lubricated journal bearings and an externally pressurized, steam-lubricated double-acting thrust bearing. The shaft is driven by a positive-displacement air motor at speeds up to 6500 rpm. Solid rotor design demonstrates good dynamic operational behavior with little bending and little unbalance response orbits. (For details see TID-4100 Suppl. 58) (See also 24: 7548) (F.S.)

25194 AN IMPROVED GRINDER-POLISHER FOR HOT CELL USE. Bender, J. H.; Johnson, K. A.; Court, D. B. (Los Alamos Scientific Lab., N. Mex.). pp 33-6 of Proceedings of Second Annual Technical Meeting, International Metallographic Society, Inc., September 8-10, 1969, San Francisco, California. /Bender,

J. H. (ed.). Los Alamos, N. Mex.; International Metallographic Society, Inc. (1970).

See CONF-690920.

A reliable, well-characterized grinder-polisher for remote operation was developed. The prime objectives in the re-designing, modification or combination of components were: ease of remote operation, reproducibility of results, and processing time. The combination of commercially available motors, motor speed controls (with electric braking), and special devices as: multipurpose free-wheeling sample holders, a quick-release pressure head attachment and a simple holddown method for grinding papers and polishing cloths are reported. Typical preparation techniques and the results of tests on the rate of material removal versus time, grit size and the number of specimen mounts with a comparison of the relative flatness of the mounts are also discussed. (auth)

25195 HIGH-INTENSITY XENON ARC LAMP FOR OLDER RESEARCH METALLOGRAPHS. Gray, R. J.; Leslie, B. C. (Oak Ridge National Lab., Tenn.). pp 121-38 of Proceedings of Second Annual Technical Meeting, International Metallographic Society, Inc., September 8-10, 1969, San Francisco, California. /Bender, J. H. (ed.). Los Alamos, N. Mex.; International Metallographic Society, Inc. (1970).

See CONF-690920.

High intensity xenon lamps are available to upgrade the performance of older metallographs. Both 150 and 450 watt xenon lamps were tested and were considered superior to the incandescent lamp in light intensity and were much more stable than the 10 A dc carbon arc lamp. The higher wattage xenon lamp exceeded the carbon arc lamp in light intensity, so there was a great saving in time and an improvement in the overall performance of a metallograph equipped with this lamp. The improvement applied to both color and black-and-white photomicrography. Despite some potential safety hazards, the excellent performance of the xenon lamp commends its use as a light source for older metallographs. (auth)

Heat Transfer and Fluid Flow

Refer also to abstracts 25165, 25191, 26784, and 26774.

25196 (AEEW-M-935) DESCRIPTION OF THE 9 MW HEAT TRANSFER RIG. Obertelli, J. D.; Owen, O. R. (Atomic Energy Establishment, Winfrith (England)). Aug 1969. 23p. Dep. CFSTI (U. S. Sales Only).

The 9 MW heat transfer rig consists basically of a high pressure water loop with which heat transfer and flow resistance data are obtained for a variety of test sections including rod clusters simulating full scale the fuel element design for the steam generating, heavy water reaction system (S.G.H.W.R.). The rig and cluster test section design are described together with the associated instrumentation. The extent of the simulation in these tests of the actual reactor situation is also identified. (auth) (UK)

25197 (AEEW-R-678) A REVIEW OF DATA ON HEAT TRANSFER TO SUPERHEATED STEAM AT HIGH SUBCRITICAL PRESSURE. Bailey, N. A. (Atomic Energy Establishment, Winfrith (England)). Feb 1970. 17p. Dep. CFSTI (U. S. Sales Only). UK 3s.

A review of the literature pertaining to superheated steam heat transfer has been carried out. Various correlations are compared and their limitations examined. The best correlation has been selected for use as a design equation at modern power plant conditions. (auth) (UK)

25198 (GEAP-10114) TWO-PHASE FLOW AND HEAT TRANSFER IN MULTIROD GEOMETRIES. Quarterly Progress Report No. 16, July 1-September 30, 1969. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Oct 1969. Contract AT(03-4)-189. 15p. Dep. CFSTI.

The circular tube test section, which was built specially for the measurement of developing two-phase flow, is described. (auth)

25199 (NASA-SP-5057, pp 35-89) TOPICS ON RANKINE CYCLE POWER SYSTEMS TECHNOLOGY. Saari, Martin J.; Heller, Jack A.; Dorsch, Robert G.; Stone, Phillip L.; Hurrell, Herbert G.; Gutstein, Martin V.; Hauser, Cavour H.

Discussions are presented aimed at stimulating further thought and inquiry into potential application of ideas to that part of the Rankine power system which converts thermal energy to drive ground-based electric generating equipment. Discussions are included on thermal aspects of once-through boilers, turbine blade erosion, materials for heaters and turbines, pump technology, and system dynamics analysis by computer. (J.R.D.)

25200 CALCULATION OF VOID VOLUME FRACTION IN THE SUBCOOLED AND QUALITY BOILING REGIONS. Rouhani, S. Z.; Axelsson, E. (Aktiebolaget Atomenergi, Stockholm). Int. J. Heat Mass Transfer; 13: 383-93(Feb 1970).

The complex problem of void calculation in the different regions of flow boiling is considered. The mechanisms and the calculations of the rates of heat transfer for vapor and liquid are described. It is assumed that heat is removed by vapor generation, heating of the liquid that replaces the detached bubbles, and in some parts, by single phase heat transfer. By considering the rate of vapor condensation in liquid, an equation for the differential changes in the true steam quality throughout the boiling regions is obtained. Integration of this equation yields the vapor weight fraction at any position. A model is presented for determining the void fractions corresponding to the calculated steam qualities. This model is compared with data from different geometries including small rectangular channels and large rod bundles. The data covered pressures from 19 to 138 bars, heat fluxes from 18 to 120 W/cm^2 with many different subcoolings and mass velocities. The agreement is generally very good. (auth) (UK)

25201 BUBBLE DYNAMICS IN SUBCOOLED NUCLEATE BOILING BASED ON THE MASS TRANSFER MECHANISM. Robin, Theodore T. Jr.; Snyder, Nathan W. Int. J. Heat Mass Transfer; 13: 305-18(Feb 1970).

A mathematical model for bubble dynamics in subcooled nucleate boiling is derived. This model is based on the mass transfer mechanism of evaporation and condensation and condensation through the bubble. The bubble is considered to be a control volume. Heat and mass balance couples transient heat transfer caused by evaporation and condensation with bubble growth and collapse. Solutions to this model compare favorably with experimental data. This model predicts mass transfer accounts for most of the heat removed from the heated surface during subcooled nucleate boiling. (UK)

25202 ABOUT THE FORMATION OF A REMAINING LIQUID LAYER DURING BOILING OF ALKALI-METALS. Kottowski, H. (Euratomforschungszentrum, Ispra, Italy). Atomkernenergie; 15: 131-7(1970). (In German).

Previous liquid metal boiling tests have shown a high tendency to superheating. Especially in a parallel channel system boiling occurs in single bubble ejection. During the ejection, a thin liquid layer remains on the wall, which varies in thickness with acceleration and velocity of the liquid and the wall is only cooled by vaporization of the remaining liquid layer. The remaining liquid layer is not to be confused with the laminar boundary layer in turbulent flow. If the ejection period is longer than the vaporization period of the remaining liquid layer, burnout may take place during this period. Approximations for the calculation of the thickness of the remaining liquid layer during the single bubble ejection are presented. A critical diameter is indicated, which means that in channels with smaller diameter the thickness of the remaining layer is only a function of the velocity and acceleration and is not influenced by a liquid back flow on the wall. The experimental results are compared with calculated results and discussed. (auth)

25203 GAS MIXING IN ROD BUNDLES. Ingesson, L.; Kjellstrom, B. (Aktiebolaget Atomenergi, Studsvik, Sweden). Int. J. Heat Mass Transfer; 13: 429-31(Feb 1970).

An experimental study of the problem of heat mixing in a direction transverse to that of flow, for turbulent flow along rod bundles is described. Results are compared with those of other workers, particularly in relation to the role of turbulent diffusion. (UK)

25204 APPROXIMATE THEORY OF A TWO-PHASE FLOW IN A CHANNEL. Prisniakov, Vladimir (CEA, Grenoble, France). Compt. Rend., Ser. A; 270: 683-5(9 Mar 1970). (In French).

A general scheme of calculation of a one-dimensional and stationary flow of a boiling fluid in a cylindrical channel is presented. The slip velocity of the gaseous phase is neglected, the vapor pressure is supposed to be low, and the mixture homogeneous and in thermodynamic equilibrium. (France)

25205 METHOD AND APPARATUS FOR MEASURING THE FLOW RATE OF A FLUID. (Gaz de France). British Patent 1,186,921. 8 Apr 1970. Priority date 10 May 1966, France.

An improved dilution method is described for measuring the flow rate of a fluid. A decay-product radioisotope is injected into the moving fluid at a certain point of a pipe of a given diameter. The radioisotope mixes with the fluid. Parent radioisotope elements are used which have daughter elements with short half-lives. The parent radioisotope is situated outside the conduit. The activity rate of the radioactive tracer is known at each instant. The specific activity of the fluid is measured at a sampling point situated downstream of the injection point, and at a sufficient distance from the injection point to ensure that the tracer is a decay product. The apparatus is described for the performance of the process. (J.C.W.)

25206 STUDY OF HEAT TRANSFER IN THE INITIAL PART OF A TUBE AT HIGH THERMAL FLUXES. Kafengauz, N. L.; Fedorov, M. I. At. Energ. (USSR); 27: 552-4(Dec 1969). (In Russian).

The heat transfer to a liquid flowing within a tube varies with the tube length and with the Reynolds number. In nuclear reactors the cooling liquid moves at high velocity through tubes having a small cross section. Experiments were run on electrically heated tubes in order to determine the values of the correction coefficient as a function of the relative tube length at various values of the Reynolds number. Correction coefficients are tabulated for relative tube lengths of 0.5, 1, 2, 5, 10, 20, 30, 40, and 60 at Reynolds numbers of 3000, 5000, 10,000, 20,000, and 50,000. These results are recommended for taking into account the effect of relative tube length during heat transfer at high thermal fluxes and high flow rates in tubes of small cross sections. (TTT)

Isotope Technology

Refer also to abstracts 25151, 25159, 25160, 25168, 25205, 25266, 25660, 25663, and 25780.

25207 (AERE-R-6330) ION IMPLANTATION TARGET STAGE FOR AN ELECTROMAGNETIC ISOTOPE SEPARATOR. Freeman, J. H.; Gard, G. A. (Atomic Energy Research Establishment, Harwell (England)). Mar 1970. 15p. Dep. CFSTI (U. S. Sales Only). UK 4s. 6d.

The implantation target assembly of the Harwell Mk I isotope separator is described. The stage extends the energy range for singly charged ions from 40 to 140 keV and facilitates the precise alignment of single crystal samples to the ion beam for channelling studies. It is fitted with a vacuum lock for the rapid change of specimens and has provision for sample heating during implantation. Two interchangeable accelerating lenses are described and the computed beam trajectories compared with the observed focussing effects. Despite some loss of uniform beam area and angular definition at the highest voltages the stage has provided a simple and reliable facility for a very wide range of both radioactive and stable ion doping experiments. In the period 1966-9 over 3000 samples have been implanted. The target stage has also been used for the production of characteristic radiation damage patterns of crystal structure. (auth) (UK)

25208 (AI-AEC-12922) LARGE RADIOISOTOPE HEAT SOURCE CAPSULE PROGRAM. TOPICAL REPORT NO. 8. CAPSULE IMPACT TESTING. Harris, J. M. (Atomics International, Canoga Park, Calif.). 23 Jan 1970. Contract AT(29-2)-2338. 62p. Dep. CFSTI.

The Large Radioisotope Heat Source Capsule (LRHSC) Program is developing the technology for a high temperature (≥2000°F), long life (≥5 years) radioisotope heat source which can be used in the space environment. The program is specifically concerned with the development of a tantalum alloy fuel capsule. Materials compatibility, fabrication processes, and assembly procedures are being defined, and the response of the capsule is being determined for conditions of biaxial creep, terminal velocity impact and launch pad abort testing. Results of the LRHSC impact testing are presented. The test program was performed to establish the behavior of the refractory metal capsule upon reentry impact. Twelve LRHS capsules were impact tested at various angles. Upon completion of testing a complete post-test analysis was performed on each capsule. (auth)

25209 (K-1786) ENGINEERING DEVELOPMENT OF AN ABSORPTION PROCESS FOR THE CONCENTRATION AND COLLECTION OF KRYPTON AND XENON. Fourth Summary Progress Report, July-December 1968. Merriman, J. R.; Pashley, J. H. (Oak Ridge Gaseous Diffusion Plant, Tenn.). 1 Apr 1970. Contract W-7405-eng-26. 24p. Dep. CFSTI.

A continuous selective absorption process for the removal of krypton-85 and xenon-155 from contaminated gas streams by preferential dissolution in a fluorocarbon solvent is being developed at the Oak Ridge Gaseous Diffusion Plant. The most important part of the ORGDP program is pilot plant testing, which is being conducted to determine feasibility and to define the main performance parameters in terms of the operating variables. The pilot plant work is supplemented by conceptual plant design work and by process optimization studies. Refrigerant-12 was used as a process solvent, pilot plant shakedown was completed, and the first phase of the formal testing program was begun. The conceptual design work was limited to further investigation of solvent radiolytic decomposition in the absorption process. The optimization studies included analyses of three absorption plants designed to treat off-gases from fuel reprocessing systems. (auth)

25210 (LA-4068) QUARTERLY STATUS REPORT ON ^{238}Pu SPACE ELECTRIC POWER FUEL DEVELOPMENT PROGRAM, JULY 1-SEPTEMBER 30, 1968. (Los Alamos Scientific Lab., N. Mex.). 31 Dec 1968. Contract W-7405-eng-36. 24p. Dep. CFSTI.

Activities in a program to develop solid solution $^{238}PuO_2$ fuels are summarized. Attention was directed to reference power densities of 1.7, 3.5, and 4.4 watts/cc and fuel diluents such as ZrO_2 and ThO_2. Screening measurements on fuel systems were conducted by crystallography, microstructure, chemical composition, density, thermal analysis, and compatibility. Studies of He release from fuels were also conducted. (J.R.D.)

25211 (LA-4089) QUARTERLY STATUS REPORT ON ^{238}Pu SPACE ELECTRIC POWER FUEL DEVELOPMENT PROGRAM, OCTOBER 1-DECEMBER 31, 1968. (Los Alamos Scientific Lab., N. Mex.). 3 Feb 1969. Contract W-7405-eng-36. 14p. Dep. CFSTI.

Results of research and development are reported on fabrication of disks of PuO_2-ZrO_2 compositions, microstructures of $^{238}PuO_2$ and $^{238}PuO_2-ThO_2$ materials, compatibility of TZM with these fuels He diffusion from fuels, thermal diffusivity of $^{238}PuO_2-ZrO_2$ compositions, solubility of solid solution fuels in seawater, and impact properties of fuel capsules. (J.R.D.)

25212 (LA-4328) QUARTERLY STATUS REPORT ON ^{238}Pu SPACE ELECTRIC POWER FUEL DEVELOPMENT PROGRAM, JULY 1-SEPTEMBER 30, 1969. (Los Alamos Scientific Lab., N. Mex.). 8 Dec 1969. Contract W-7405-eng-36. 15p. Dep. CFSTI.

Research results are reported on preparation of solid solution cermets, properties of actinide oxide pellets, helium migration in fuels, and design and installation of metallurgy equipment. A schedule for developing solid solution cermets is included. (J.R.D.)

25213 (NP-tr-1884) SEPARATION NOZZLE DEMONSTRATION PLANT FOR URANIUM ENRICHMENT. Becker, E. W.; Bier, W.; Frey, G.; Schuette, R. Translated by G. H. Wheelhouse (Australian Atomic Energy Commission Research Establishment, Lucas Heights), from Atomwirt., Atomtech.; 14: 249-51(May 1969). 8p. Dep. CFSTI (U. S. Sales Only).

An abstract of this article, prepared from the original, appeared as NSA 23: 33336. (auth) (Australia)

25214 (NP-tr-1885) ECONOMIC ASPECTS OF A EUROPEAN URANIUM ENRICHMENT PLANT. Bruechner, H. J. Translated by G. H. Wheelhouse (Australian Atomic Energy Commission Research Establishment, Lucas Heights), from Atomwirt., Atomtech.; 14: 72-5(Feb 1969). 13p. Dep. CFSTI (U. S. Sales Only).

An abstract of this article, prepared from the original language, appeared as NSA 23: 17704. (auth) (Australia)

25215 (SC-DR-70-152) EVALUATION OF PROJECT FIRESCAN AS AN RTG HEAT SOURCE SEARCH AND DETECTION SYSTEM. Entrekin, J. L.; Keller, L. L. Jr. (Sandia Labs., Albuquerque, N. Mex.). Mar 1970. 29p. Dep. CFSTI.

The U. S. Forest Service Firescan system was evaluated as an airborne detection system for use in the search, detection, and recovery of earth-impacted radioisotope heat sources. Test data and photographic results are presented. (auth)

25216 (USNRDL-TR-69-75) IMPLICATIONS OF SUBSTITUTION OF STRONTIUM OXIDE FOR STRONTIUM TITANATE IN TERRESTRIAL/MARINE RADIOISOTOPIC POWER UNITS. Mikhail, S. Z.; James, L. R. (Naval Radiological Defense Lab., San Francisco, Calif.). Jun 1969. 101p. (WASH-1151). Dep. CFSTI.

Comparison is made between the principal physical-chemical characteristics of strontium-90 oxide and strontium-90 titanate. Weights of component materials were compared for two 60 W(e) radioisotopic generators each employing one of the two different strontium fuels. Exposure modes that may accidentally occur during transport, implantment or usage of the generators are examined and relative hazards estimated for each mode. A three dimensional ocean diffusion model is discussed and digital computer codes for both an instantaneous and a continuous fuel release are described. Results of a parametric study showing the effect of varying the empirical constants of the diffusion model are presented. The biological implications of an accidental release of strontium-90 oxide in the ocean are summarized. This summary includes a description of a migratory marine organism contamination model along with calculated results. (auth)

25217 (WANL-3800-45) PHASE I, QUARTERLY PROGRESS REPORT, DECEMBER 1, 1969-FEBRUARY 28, 1970. (Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.). Apr 1970. Contract AT(30-1)-3800. 86p. (WANL-PR(SS)-37). Dep. CFSTI.

Research and development on SNAP-23A are reported in sections on program management, product assurance, system design, materials and components testing, and safety analysis. (J.R.D.)

25218 ON THE ENRICHMENT OF THE STABLE ISOTOPE ^{34}S IN THE HYDROGEN SULPHITE–SULPHUR DIOXIDE SYSTEM. PART 2. THE NH_4HSO_3/SO_2 SYSTEM. Stiehl, G.; Muehle, K. (Institut fuer Stabile Isotope, Leipzig). Isotopenpraxis; 5: 429-32(1969). (In German).

The system NH_4HSO_3/SO_2 was investigated to determine the dependence of the overall separation factor of ^{34}S enrichment on NH_4HSO_3 concentration and at temperatures of 20 and 80°C. For single stage factor at 20°C was found a dependence on the NH_4HSO_3 concentration and at 80°C for the range of 3 to 10 moles NH_4HSO_3/l was determined to ~ =1.007. The HETP values at 20°C varied between 1.23 and 5.55 cm and at 80°C between 0.93 and 2.12 cm. (auth)

25219 DYNAMICS OF THE SOLID PHASE IN THE ROTARY KILN. Zablotny, W.; Lelental, M.; Winnicki (Inst. of Nuclear Research, Warsaw). Isotopenpraxis; 5: 432-6(1969). (In German).

Solid phase flow rates and axial mixing coefficients have been determined in a rotary kiln for ceramic production by using tracer elements. A simplified technique of determining both mean residence time of the charge in the point under measurement and variance of the decay curves has been used in evaluating the experimental data. It was found that the flow rate of the charge in kiln axis direction is subjected to oscillating fluctuations, in which moisture content of the solid phase shows great influence on the flow rate. The experimental axial mixing coefficient of the solid phase is also subjected to some variations and attains its maximum value in the heating zone. (auth)

25220 SOURCE SHAPES OF GAMMA IRRADIATION PLANTS UTILIZING SPENT FUEL ELEMENTS. Suckow, W. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Isotopenpraxis; 5: 447-55(1969). (In German).

An important aspect for radiation utilization in gamma irradiation plants using spent reactor fuel elements is the shape of the sources when the special source density distribution is considered. Parameters have been derived, with the aid of which optimum versions of the source shape may be determined for various conditions made for the material to be irradiated. Formulas for calculating the radiation fields are given for five fundamental shapes of the sources. Using the parameters obtained by this way the different source shapes considered have been compared to each other. The optimum conditions derived from this are given. (auth)

25221 ON THE ENRICHMENT OF THE STABLE ISOTOPE ^{34}S IN THE HYDROGEN SULPHITE–SULPHUR DIOXIDE SYSTEM. PART 3. INFLUENCE OF THE PACKING TYPE ON EFFICIENCY OF THE SEPARATION. EVALUATION FOR CONSTRUCTION OF A SEPARATION PLANT. Stiehl, G.; Winkler, R.; Muehle, K. (Institut fuer Stabile Isotope, Leipzig). Isotopenpraxis; 5: 437-8 (1969). (In German).

The separation efficiencies of five types of packing were tested. The possibility for the production of ^{34}S with 50 to 90 at. % enrichment in a pilot plant is discussed. (auth)

25222 THERMAL DIFFUSION AND THE SENFTLEBEN–BEENAKKER EFFECT. Hidalgo, M. A.; Saviron, J. M.; Gonzalez, D. (Univ., Zaragoza, Spain). Physica; 46: 41-3(23 Feb 1970).

The thermal-diffusion separation of the paramagnetic isotopic mixture $^{16}O^{18}O/^{16}O^{16}O$, in a Clusius–Dickel column in the presence of an axially superimposed magnetic field, was studied. No effect on the thermal diffusion separation factor was found in the range of H/p values 1.6 to 15, within the experimental accuracy of 0.1%. (auth)

25223 EFFECTS OF GAMMA IRRADIATION ON THE AVAILABLE NITROGEN STATUS OF SOILS. Singh, B. R.; Kanehiro, Y. (Banaras Hindu Univ., India). J. Sci. Food Agr.; 21: 61-4(Feb 1970).

Five Hawaiian soils were irradiated at various levels of gamma irradiation and analysed for available (NH_4 and NO_3) nitrogen content immediately after irradiation, and after periods of incubation. The release of NH_4-N generally increased with increasing dosages in all soils, while NO_3-N decreased in some soils. Incubation studies showed that the loss of NO_3-N continued even after several days of irradiation. The rate of NH_4-N mineralization in irradiated soils was highest during the first seven days and declined later on. (auth)

25224 RADIO-ACTIVE IODINE SOURCES AND THEIR PRODUCTION. (to Atomic Energy of Canada Ltd.). British Patent 1,187,368. 8 Apr 1970. Priority date 2 Aug 1968, Canada.

A radioactive point source of ^{125}I comprises a particle of activated charcoal of such particle size as to define a point source and having absorbed on it an amount of radioactive iodine to give a desired amount of radiation output from the source. Preferably the particle of charcoal is a 1- to 5-mg granule or a pellet of finely divided activated charcoal powder and has an output of 10 mCi to 2 Ci. (B.L.M.)

25225 APPLICATION OF THE GAS LOOP FOR PRODUCTION OF RADIOACTIVE ISOTOPES IN THE REACTOR. Ludziejewski, Jerzy; Luszczynski, Ryszard (Inst. of Nuclear Research, Swierk, Poland). Nukleonika; 14: 825-30(1969).

Short-lived gaseous isotopes were produced in the reactor gas loop for nuclear spectroscopy studies. The time of flow of the active gas from the irradiation chamber to the source chamber, situated 40 m from the core, was about 15 sec at 0.3 atm pressure in the loop. Using the loop, ^{125}I of high radiation purity may be produced from natural or enriched xenon. The main feature of this procedure is that the irradiation process is separated from the transformation process of ^{125}Xe into ^{125}I. In this way all the impurities remain in the irradiation chamber, and the pure ^{125}I is obtained there where ^{125}Xe decays to ^{125}I. (auth)

25226 ENRICHMENT OF BROMINE ISOTOPES IN A THERMAL DIFFUSION TUBE PLANT WITH HYDROGEN CIRCULATION. Meinrenken, J. (Univ., Goettingen, Ger.). Chem.-Ing.-Tech., 41: 1131-2(Oct. 1969). (In German).

A separation installation with 12 separation tubes was constructed using hydrogen circuits, instead of Kr. The installation constructed was described and tested for the enrichment of Br isotopes with H_2-stabilized HBr. The installation was operated for 57 days and $H^{79}Br$ enrichments of 91.20% were obtained at the light end. The use of hydrogen as the auxiliary gas permitted higher enrichments in shorter times with a continuous operation. (J.S.R.)

25227 AUTOMATIC POSITIONING APPARATUS FOR IRRADIATION. (to Atomic Energy of Canada Ltd.). British Patent 1,187,895. 15 Apr 1970. Priority date 10 Aug 1967, Canada.

The apparatus described includes a radiation source mounted in its housing, a support for the medical patient, and control for movements between housing and the support to ensure irradiation of a predetermined part of the patient with energy from the source. Flow charts are given for the digital automatic control system for effecting positioning of the patient relative to the radiation source. (J.C.W.)

25228 RADIATION SOURCE CAPSULE. (to Industrial Nucleonics Corp.). British Patent 1,187,210. 8 Apr 1970. Priority date 2 Jun 1966, United States.

The design is given of a radiation source capsule which eliminates changes in the emitted radiation due to shifting of the emitting material or because of movement of an attenuating material into a position within the capsule where it reduces the radiation emanating from the source capsule. The source material is americium-241 oxide in particulate form. Attenuating masses and radioisotope particles may be maintained substantially immobile within the capsule while permitting passage of the gas formed by the decay of the radioisotope into a gas reservoir within the capsule. (J.C.W.)

Materials Testing

Refer also to abstracts 25176, 25631, 25661, 25815, 26696, 26700, 26848, and 26849.

25229 (ANL-7417, pp 41-7) DEVELOPMENT OF TECHNIQUES OF FABRICATION AND TESTING. (Argonne National Lab., Ill.).

Developmental effort devoted to ultrasonic testing, neutron radiography, x radiography, noise suppression in electromagnetic test systems, nondestructive tests of fast reactor components, and equipment and methods for hot cells is summarized. (J.R.D.)

25230 (IN-1369) ACOUST-S: A DIGITAL PROGRAM FOR ACOUSTIC TRIANGULATION OF SPHERICAL VESSELS. Waite, E. V. (Idaho Nuclear Corp., Idaho Falls). Mar 1970. Contract AT(10-1)-1230. 22p. Dep. CFSTI.

ACOUST-S was written as an extension of the original triangulation program ACOUST (IDO-17280) for the purpose of locating structural flaws on spherical pressure vessels. The program operates on time-of-arrival differences between unique acoustic transducers to locate points of structural flaw on spherical vessels. Flaw location is achieved by hyperbolic triangulation techniques. The program is designed to permit the location of sensors on inlet-outlet piping connected to the test vessel. Any portion of a spherical shape may be tested for acoustic emission points. ACOUST-S is written in FORTRAN IV for use on the IBM 360 computer. The program requires 32,632 bytes of storage for execution. Standard input/output assignments are used in the program. An average triangulation problem will require about 0.04 minute execution time on the IBM 360/75 computer when using the FORTRAN IV H level 2 compiler. (auth)

25231 ELECTRON-MICROSCOPICAL RADIOAUTOGRAPHY OF FIBERS. Paul, D.; Groebe, A. (Institut fuer Faserstoff-Forschung Teltow, Berlin). Isotopenpraxis; 5: 464-6(1969). (In German).

Radioautographic methods using electron microscopes for film examination are described for fibers which are tagged using ^{14}C and ^{65}Zn tracers. (J.R.D.)

25232 IMPROVEMENTS IN OR RELATING TO STRAIN MEASURING TECHNIQUES. Holister, Geoffrey Stanley; Luxmoore, Anthony Rodger; Parish, Colin Clive (to United Kingdom Atomic Energy Authority). British Patent 1,185,477. 25 Mar 1970. Filed 28 Mar 1966.

Reference is made to methods for the measurement of static strains in engineering materials, especially applicable to the periodic checking of the strains suffered by engineering structures and components in service, including the routine inspection of pressure vessels. It was previously proposed to utilize a technique involving producing surface scratches in two orthogonal directions on the specimen to be tested, an initially produced replica of the scratches being compared with a replica of the scratches after the specimen had been subjected to load. Distortions of the second replica relative to the first give an indication of the strain. The technique described enables strain measurement by comparison of replicas to be carried out in any direction, instead of just the two orthogonal directions, and comparison and evaluation of replicas are facilitated by making use of Moire fringes which are observed when superimposed grids are slightly displaced. A pattern is formed on the specimen by causing a scratching tool to rotate about a stationary center over the surface and charging the radius of rotation by small amounts to produce a series of closely pitched arcuate scratches on the surface. A pattern in the form of an Archimedean spiral may be produced by maintaining the rate of change of the radius of rotation of the tool in constant proportion to the rate of rotation, and this proportion may be predetermined to give a scratch density of at least 1000 per inch measured radially from the center. A projection of a replica of the arcuate scratches may be superimposed as a master to produce Moire fringes for the evaluation of distortion. A suitable scratch cutter device is also described. (UK)

25233 NONDESTRUCTIVE TESTING. Egerton, H. B. (ed.). Harwell Post-Graduate Series. Oxford; Oxford University Press (1969). 240p. 50s.

Nondestructive testing methods developed for the United Kingdom Atomic Energy Authority were surveyed. Data processing, electronic techniques, and the implications of advanced techniques for designers are discussed. Both established methods and those under development are reviewed. (UK)

25234 NEUTRON RADIOGRAPHY WITH A 5.5-MeV LINEAR ACCELERATOR: BERYLLIUM SOURCE. Hunt, C. A. (RARDE, Fort Halstead, Eng.). Brit. J. Non-Destruct. Test.; 11: 78-85 (Dec 1969).

The feasibility of using a 5.5 MeV linear accelerator as a source of thermal neutrons for neutron radiography was investigated. The neutrons were produced by bombardment of Be metal with x rays from the accelerator, which had been in use for normal x-radiography for several years. The radiographs produced are believed to represent the first practical results obtained in UK with neutrons other than from a reactor. Among matters considered are image detection, necessitating the use of converter screens to convert the neutron flux into γ, β, or light radiation, since photographic emulsions are insensitive to neutrons; also moderating assemblies, available neutron flux, x- and γ-ray contamination of the neutron beam, collimation, and film screen combinations. A comparison was made of x-ray and neutron radiographs. It was concluded that the radiographs so obtained usefully complement normal x radiographs, particularly for certain materials. (UK)

25235 FRACTURE BEHAVIOR INVESTIGATIONS UNDER THE USAEC-SPONSORED HEAVY SECTION STEEL TECHNOLOGY PROGRAM. Witt, F. J.; Merkle, J. G.; Kooistra, L. F. (Oak Ridge National Lab., Tenn.). pp 709-21 of Pressure Vessel Technology. Pt. II. New York; American Society of Mechanical Engineers (1969).

From 1st International Conference on Pressure Vessel Technology, Delft, Netherlands. See CONF-690906(Pt.2).

The Heavy Section Steel Technology Program (HSST) is an engineering investigation designed to assess the structural safety of the pressure vessels of water-cooled nuclear reactor electrical power plants. The main emphases are on the effects of flaws, material inhomogeneities, and discontinuities under startup, operating, cooldown, and accident conditions. The overall program is outlined, and the more pertinent data are summarized. Special emphasis is placed on the investigations of the effects of thickness on fracture behavior. (auth)

25236 APPLICATION OF ULTRASONIC EXAMINATION ON THE WELD JOINT OF PRESSURE VESSEL. Takaoki, A. (Japan Steel Works, Ltd., Muroran). pp 951-8 of Pressure Vessel Technology. Pt. II. New York; American Society of Mechanical Engineers (1969).

From 1st International Conference on Pressure Vessel Technology, Delft, Netherlands. See CONF-690906(Pt.2).

Difficulties arise when shear-wave tests on weld seams of reactor pressure vessels are performed if these vessels have stainless-steel weld overlays. Several proposals are presented to cope with this problem. Several other applications of ultrasonic tests on pressure vessels are also presented. (auth)

25237 INTEGRITY SURVEILLANCE OF PRESSURE SYSTEMS BY MEANS OF ACOUSTIC EMISSION. Hutton, P. H. (Battelle Northwest Labs., Richland, Wash.). pp 1017-32 of Pressure Vessel Technology. Pt. II. New York; American Society of Mechanical Engineers (1969).

From 1st International Conference on Pressure Vessel Technology, Delft, Netherlands. See CONF-690906(Pt.2).

Acoustic emission is defined as the elastic waves produced in a solid material by energy released as the material is deformed or fractured. These waves can be detected at the surface of the material with high-sensitivity transducers. This provides the basis for a new technique for monitoring metal structures, pipes, pressure vessels, etc., both during fabrication and during system operation, to detect flaw formation and growth before failure occurs. The basic phenomena were first studied in the United States and Germany in the late 1940's and early 1950's. The first practical application of acoustic emission as a surveillance technique was in the United States in 1964 when it was used successfully to detect flaw growth in rocket-motor casings during hydrostatic proof testing. The monitor system permitted depressurization of faulty casings for repair prior to failure under test. Extending the application to continuous surveillance of complex systems such as a reactor primary pressure system in the field during operation, however, imposes significantly more demanding requirements. Flaw-detection resolution potential using acoustic emission far exceeds that of any of the more conventional nondestructive techniques such as ultrasonics, radiography, etc. It is, however, limited to detection of an active strain or flaw area; it will not detect static flaws. The development work conducted at Battelle-Northwest directed toward applying acoustic emission to detect flaw growth in nuclear-reactor pressure systems during reactor operation, and the application of acoustic emission to detect formation of cracks in welds as they cool, metal fatigue, stress corrosion cracking, and as a surveillance tool in studying pressure-vessel fracture modes are discussed. (auth)

25238 MICROFRACTOGRAPHIC AND X-RAY ANALYSES OF PIPING FAILURE IN FATIGUE. Ando, Y. (Tokyo Univ.); Iida, K.; Miyoshi, S. pp 1203-12 of Pressure Vessel Technology. Pt. II. New York; American Society of Mechanical Engineers (1969).

From 1st International Conference on Pressure Vessel Technology, Delft, Netherlands. See CONF-690906(Pt.2).

The fractographic analysis of service failure offers important criteria to improve structural design. Fracture surfaces of pressure tubes in a nuclear power plant were studied by microfractographic and x-ray microbeam techniques and compared with reference fracture surfaces obtained by fatigue tests on full-size tube specimens of the same material. Observations on striation spacing and plastic-deformation depth provided the basis for suitable countermeasure to possible failure. (auth)

25239 BIAXIAL FATIGUE OF 1018 MILD STEEL AT LOW ENDURANCE. Havard, D. G. (Ontario Hydro Research Labs., Toronto); Topper, T. H. pp 1267-77 of Pressure Vessel Technology. Pt. II. New York; American Society of Mechanical Engineers (1969).

From 1st International Conference on Pressure Vessel Technology, Delft, Netherlands. See CONF-690906(Pt.2).

A study was made of the fatigue behavior of normalized 1018 mild steel at room temperature under fully reversed, constant-amplitude, uniaxial, torsional, and biaxial cyclic loading in the 2,000 to 100,000 cycle-life range. Except for reference uniaxial tests conducted in air, all specimens were tested immersed in hydraulic oil. For the torsional tests, thin-walled tubular specimens were used, and shear-strain amplitude was controlled using the output of a clip-on twist transducer. The biaxial tests were performed using a specially designed loading device with which simultaneous axial loading and direct internal and external pressurization was applied to thin-walled tubular specimens. Five stress ratios were produced in this equipment. The output of one of the two strain transducers, generally that measuring the larger principal strain, was used as the controlling signal for the servo-controlled testing system in which the biaxial loading device was mounted. The fatigue strength for each series of data is found to conform to the Coffin-Manson relationship; $\Delta e_p = AN^B$, for plastic strains, to the Basquin relationship; $\Delta e_e = CN^D$, for elastic strains and to the sum of these two relationships; $\Delta e_t = AN^B + CN^D$, for total strains. Tests at strain ranges required to produce fatigue at lives shorter than 2,000 cycles resulted in failure by buckling attributed to cyclic-strain softening. Fatigue lives at the seven stress ratios tested were compared to the lives predicted by the distortion strain energy, maximum stress, maximum shear-stress, and maximum strain criteria. A modified form of the maximum shear-stress criterion was found to provide the best fit to the data. (auth)

25240 STUDY OF HIGH TEMPERATURE CHARACTERISTICS OF A COILAYER VESSEL. Uno, T.; Iwasaki, Y. (Mitsubishi Heavy Industries, Ltd., Kobe, Japan). pp 1279-89 of Pressure Vessel Technology. Pt. II. New York; American Society of Mechanical Engineers (1969).

From 1st International Conference on Pressure Vessel Technology, Delft, Netherlands. See CONF-690906(Pt.2).

Recently the problem of low-cycle fatigue strength has been taken up not only for nuclear reactors, but also for general high-temperature and high-pressure vessels. In view of the above point, high-temperature endurance tests and low-cycle fatigue tests in room temperature were carried out on coilayer vessels. In these tests the coilayer vessel showed excellent characteristics. Also, it has been proved that the theoretical analysis presented for the transient temperature and thermal stress can be put into full practical use in design by comparison with the experimental values. (auth)

25241 LOW-CYCLE FATIGUE OF PRESSURE VESSELS WITH BUTT-WELDED NOZZLES. Kameoka, T.; Sato, E.; An, B.; Sato, Y. (Kobe Steel, Japan). pp 1291-1301 of Pressure Vessel Technology. Pt. II. New York; American Society of Mechanical Engineers (1969).

From 1st International Conference on Pressure Vessel Technology, Delft, Netherlands. See CONF-690906(Pt.2).

Fatigue data are presented for pressure vessels with butt-welded nozzles of the through type as well as the flush type. The loads are due to cyclic internal pressures in the range of 10^3 to 10^4 cycles to failure. The effects of both types of nozzles on low-cycle fatigue characteristics are discussed, and it is concluded that the through nozzles are stronger. Characteristics of residual strain and strain amplitude at the inner nozzle corner are given as a function of pressure. Strain amplitude is constant throughout most of the life. (auth)

25242 AN ASSESSMENT OF THE FATIGUE OF WELDED PRESSURE VESSELS. Jerram, K. (Berkeley Nuclear Labs., Eng.). pp 1303-17 of Pressure Vessel Technology. Pt. II. New York; American Society of Mechanical Engineers (1969).

From 1st International Conference on Pressure Vessel Technology, Delft, Netherlands. See CONF-690906(Pt.2).

The scientific bases of the fatigue design methods of BS 1515 and Section III of the ASME Boiler and Pressure Vessel Code have been compared. The fatigue design procedure of Section III of the ASME code has been used to analyze the results of a large number of pressure-vessel fatigue tests. It is demonstrated that in some cases failure occurred at the ASME section III design life, leaving no margin of safety to cover adverse factors, not present in the tests analyzed, such as long-term corrosion and irradiation. The BS 1515 fatigue-life equation is shown to be satisfactory for higher strength steels, but unduly conservative for lower strength steels for lives above 10^4 cycles. A modification to the ASME Section III carbon and low-alloy steels fatigue-design curve is proposed to introduce an adequate safety margin. Analysis of the weld failures in the pressure-vessel fatigue tests examined suggests that 2 is a suitable value for the stress-concentration factor for a weld profile, and that the value of 4 for fillet welds specified in Section III of the ASME Code is rather conservative for endurances up to 10^5 cycles. (auth)

25243 NOTCHED HIGH-STRAIN FATIGUE BEHAVIOR OF THREE LOW-STRENGTH STRUCTURAL STEELS. Krempl, E. (Rensselaer Polytechnic Inst., Troy, N. Y.). pp 1319-28 of Pressure Vessel Technology. Pt. II. New York; American Society of Mechanical Engineers (1969).

From 1st International Conference on Pressure Vessel Technology, Delft, Netherlands. See CONF-690906(Pt.2).

The notched high-strain fatigue behavior of three low-strength structural steels, carbon steel, 2.25 Cr–1 Mo alloy steel, and type 304 stainless steel, was investigated. Grooved cylinders with a uniaxial elastic-stress concentration factor of $K_t = 3.3$ were tested under completely reversed, load controlled conditions. The axial and transverse cyclic strains were measured in the root of the notch by $^1/_{64}$-in. strain gauges. Fatigue crack initiation and final failure were determined in the range of 100 to 100,000 cycles. A significant decrease in the notch-root strain range with cycling occurs above about 1.4 percent total notch-root strain range. The decrease corresponds to the observed cyclic strain hardening characteristic of smooth-bar specimens. No shakedown to elastic action was observed. Fatigue-strength reduction factors were defined and derived for crack initiation (0.005 to 0.015-in. long crack in the root of the notch). These factors can be considerably higher than the theoretical elastic stress-concentration factors. Crack growth consumed at least 60 percent of the total life. Separation of the specimens occurs when the true stress is around the true ultimate tensile strength of the steels. Some of the concepts of present design practices against fatigue of pressure vessels may be re-evaluated in the light of these results. The treatment of discontinuities and the shakedown theorem are two such areas. (auth)

25244 EDDY CURRENT AND RADIOGRAPHIC EVALUATION OF SODIUM-COOLED FAST BREEDER REACTOR FUEL ELEMENT. Cwynar, J. C.; McGeary, R. K. (Westinghouse Electric Corp., Cheswick, Pa.). Mater. Eval.; 28: 111-15(May 1970).

Short uranium-plutonium carbide ceramic pellets are bonded inside stainless steel tubing with sodium to produce a fuel element after end sealing. The eddy current test requires use of a point probe to eliminate pickup of unwanted signals such as the numerous pellet interfaces and lateral pellet shifting. Voids as small as 0.03-in.-diameter are detected in the sodium bond of continuously varying thickness during rapid rotation of the fuel pin under the probe. A quantitative correlation of size of the void and its signal is presented. Unique techniques are described for the correlation of pellet positioning, as revealed by radiography, with eddy current traces and other tests. (auth)

Protective Structures

25245 (AD–700939) MOTION OF SUBSURFACE SOIL INCLUSIONS SUBJECTED TO SURFACE BLAST LOADING: RESULTS OF SERIES IV TESTS. Final Report, April 1966–April 1969. White, C. R. (Naval Civil Engineering Lab., Port Hueneme, Calif.). Jan 1970. 29p. (NCEL-TR-656). CFSTI.

Experiments and analyses between 1966 and 1969 on the behavior of objects buried in dry sand added information on shape effects at blast overpressures from 14 to 250 psi to the previous information about mass effects. Two shapes (cubic and triangular prismatic), each at two different masses (greater and less than the encompassing soil), were tested. Shape had no discernible effect on relative displacement between buried objects and the soil. Shape had a greater effect than mass on accelerations experienced by the buried objects, with the objects presenting a flat face to the stress wave receiving the greater acceleration. (auth) (USGRDR)

25246 (AD–701081) THE HOME FALLOUT PROTECTION SURVEY IN MICHIGAN: ITS IMPACT ON THE GENERAL PUBLIC. (Michigan State Univ., East Lansing. Dept. of Communication). May 1968. Contract DAHC20-67-C-0119. 309p. (HFPS-1). CFSTI.

A summary of responses, in tabular form, to all questions asked of 1,915 respondents located throughout Michigan in assessment of the Office of Civil Defense's Home Fallout Protection Survey (HFPS) is presented. The data were gathered at four separate time periods — immediately before HFPS (October, 1967), and one week, one month, and four months after the survey began. The tables are organized into the following main headings: general reactions to the survey; evaluation of survey desirability, reactions to survey booklets; salience of public affairs problems and new topics during the survey; civil defense attitudes; civil defense information and plans; communication behavior with respect to civil defense; general communication behavior; and basic demographic and control variables (e.g., sex, age, income, employment, etc.). Each table in the report presents the total percentage of responses to a question, and breaks down these percentages by sex of respondent, and their geographical location in the state. (auth) (USGRDR)

25247 (AD-701088) EXISTING STRUCTURES EVALUATION. PART III. STRUCTURAL STEEL CONNECTIONS. Final Report. Jensen, Gordon F. (Stanford Research Inst., Menlo Park, Calif.). Dec 1969. Contract DAHC20-67-C-0136. 94p. CFSTI.

Results of an investigation of the manner in which structural steel buildings may fail and to evaluate the strength of these connections relative to the strength of the beam and column elements are presented. A review was made of the literature describing building failures, with emphasis on structural steel frame structures. Building failures resulting from earthquake shock as well as an example of full scale testing of destruction were evaluated. A statistical sampling of U. S. fallout shelters was made with respect to such selected items as the year of construction, type of structural frame, number of stories, floor area, and general construction characteristics. Equations were selected and developed by which the stresses in various steel connection elements may be computed. Connections were examined in accordance with the classifications of simple, semirigid, and rigid. A computer analysis was made to a 'typical' ten-story frame building. Sensitivity analyses were made by comparing a range of peak overpressures and the maximum ductility ratios prepared for selected frames. (auth) (USGRDR)

Radioactive Material Handling

Refer also to abstracts 25097, 25099, 25180–25186, 25188, and 25190.

25248 (EUR-4454) ISPRA JRC RADIOACTIVE LIQUID WASTE PROCESSING PLANT. Report of Activities, 1963-1968. Lopes Cardozo, R.; Vaccarezza, J.; Vanuzzi, S. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). 15 Oct 1969. 22p. (In French). Dep. CFSTI (U. S. Sales Only). EUR FF 4,45.

Details of the main modifications and improvements made in the Waste Processing Plant at the Ispra JRC during the period 1963 to 68 are given, together with an enumeration of all the residual solutions treated. (auth)

25249 (ORNL-4554) MATERIAL FORM FOR MAXIMUM SAFETY IN THE SHIPPING OF ALPHA-EMITTING MATERIALS. Brooksbank, R. E.; Carr, W. H. (Oak Ridge National Lab., Tenn.). Apr 1970. Contract W-7405-eng-26. 13p. Dep. CFSTI.

Plutonium and other alpha-emitting materials are commonly shipped from a chemical processing plant in the form of nitrate solutions. Whereas this is currently an acceptable practice, the anticipated shipping requirements of the LMFBR program make reexamination of the safety aspects of the shipping form of such materials advisable. Results of a study of the safety considerations involved in choosing a form for shipping alpha-emitting materials are presented. A summarization of an economic comparison of liquid and solid forms for rail and truck shipment is included. Although the shipment of liquids has certain inherent advantages, the shipment of solids is significantly less expensive and is also much safer for any given container. Data are presented to show that safety considerations tend to favor the shipment of alpha-emitting materials in the form of a solid; this solid form will probably be an oxide; and the safest physical form is a microsphere. (auth)

25250 (STI/DOC-10/101) STANDARDIZATION OF RADIOACTIVE WASTE CATEGORIES. Report of a Panel Held in Vienna, 6-10 November 1967. Technical Reports Series No. 101. (International Atomic Energy Agency, Vienna (Austria)). 1970. 18p. IAEA $1.00.

The standardization of radioactive waste categories is discussed under the following subjects: present state of waste classification; premises for waste standardization; categories of liquid, solid, and gaseous radioactive wastes; lower limit of activity of radioactive wastes; and color indication of radioactive waste categories. (J.C.W.)

25251 (SZS-16/69) ASPECTS OF THE RELEASE OF RADIOACTIVE MATERIALS FROM NUCLEAR INSTALLATIONS INTO THE ENVIRONMENT AND CONSEQUENCES OF THE DISPOSAL OF RADIOACTIVE WASTE. Roehnsch, W. (Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany)). Dec 1969. 21p. (In German). Dep. CFSTI (U. S. Sales Only).

The importance of the environmental capacity for the release of radioactive materials from nuclear installations is pointed out. Its dependence on natural characteristics and the utilization of the environment as well as on the maximum permissible radiation burden of the inhabitants is discussed, especially for surface waters. From the basic principle of radiation protection the request for a well founded minimum exploitation of the environmental capacity is derived. An estimation of the capacity of the surface waters of the G.D.R. and the Baltic Sea shows that for a long time the disposal of low-level radioactive wastes is possible when all the possible means of the water processing facilities are applied and permanently improved. (auth)

25252 (SZS-17/69) SOME PROBLEMS OF THE DISCHARGE OF RADIOACTIVE GASES AND AEROSOLS FROM NUCLEAR INSTALLATIONS INTO THE ATMOSPHERE. Zindler, H. (Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany)). Dec 1969. 16p. (In German). Dep. CFSTI (U. S. Sales Only).

A model was used to evaluate future possibilities for the discharge of gaseous radioactive wastes from nuclear installations and fuel reprocessing plants. The necessity of decreasing the specific radioactive discharges is pointed out taking into consideration the increasing number of nuclear installations and thus the increasing part of the population living in the environment of such installations. The problem of the discharge of ^{85}Kr is discussed in detail. The discharge of ^{85}Kr must occur with regard to the maximum permissible exposure in the environment of the installation, the maximum permissible concentration in frontier crossing air masses and the capacity of the total atmosphere. In the German Democratic Republic it is necessary to provide installations capable of storing the ^{85}Kr originated in reprocessing plants. (auth)

25253 TREATMENT OF WEAKLY RADIOACTIVE SOLID WASTES OF THE C.C.R. EURATOM CENTRE AT ISPRA. Mosselmans, G. (CCR-EURATOM, Ispra, Italy). G. Fis. Sanit. Prot. Radiaz.; 12: No. 1, 6-13(1968). (In French).

The Euratom center of Ispra is situated in a thickly populated region. For this reason the treatment of the radioactive waste of necessity involves the use of elaborate, up-to-date and sometimes expensive methods. Moreover, the treatment itself must be specific for every type of waste considered separately. The solid residues are first sorted out into compressible and noncompressible waste. They then undergo the treatment appropriate to their respective category viz. reduction in size by compression before being finally rendered insoluble in bitumen. The various stages of treatment call for special apparatus, which is described. A cost study of the treatment was carried out according to the costing program of the IAEA and is given for the first half of 1967. (Excerpta Med.)

25254 RADIOACTIVE WASTES. Bryant, Pamela M. pp 65-77 of Technological Injury. /Rose, J. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1969).

The conservative approach applied to radioactive waste management has limited radiation doses to mankind to very low levels. A description is given of how this approach is applied to radioactive waste arising in the field of nuclear power and how the relatively low activity wastes discharged to the environment may give radiation doses to man. Legislation regarding waste management is briefly described. Nuclear power, research and development laboratories, hospitals, and radium and thorium industries are sources of radioactive wastes. Liquid, solid, and airborne wastes are discussed for methods of treatment and disposal. Pathways from environment to man include dispersion in air and water. (J.C.W.)

INSTRUMENTATION

Radiation Detection Instruments

Refer also to abstract 25527.

General Detectors and Monitors

Refer also to abstracts 25330, 25332, and 25347.

25255 (AD–689453) COMPARISON OF NEWER LIQUID SCINTILLATION SOLUTIONS. Schmid, Peter (Letterman Army Inst. of Research, San Francisco, Calif.). 20 Jun 1969. 14p. (LAIR–2). CFSTI.

In liquid scintillation counting of radioactive beta emitters, quenching agents interfere with energy transfer processes. It is shown that the quenching effect of distilled water, acid and basic reagents depends on the fluor and solvents as well as cosolvents such as Biosolve, Triton X, etc. Four systems including the Bray solution, Triton X-100, Biosolve BBS-3, and BBOT are compared. It is shown that with the Biosolve system, hydrogen peroxide in moderate concentration decreases the counting efficiency very little. This system is thus advantageous, where wet oxidation of the sample is performed prior to liquid scintillation counting. (auth) (USGRDR)

25256 (BNWL–1307(Pt.3)) ANNUAL REPORT FOR 1969 TO THE USAEC DIVISION OF BIOLOGY AND MEDICINE. VOLUME II. PHYSICAL SCIENCES. PART 3. INSTRUMENTATION. Hildebrand, B. P. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Mar 1970. Contract AT(45-1)-1830. 16p. Dep. CFSTI.

Experimental and computational studies of the x ray-to-alpha ratios for plutonium isotopic mixtures are briefly outlined. The development of surface-contoured diodes for plutonium determination in wounds is discussed, and the development of a phoswich detector for the lung counting of plutonium is described. Also, the development of a surface-barrier detector for radon monitoring in small-animal exposure chambers is summarized. (W.H.K.)

25257 (KFK–1003) CONSTRUCTION AND INSTRUMENTATION OF A THREE-PARAMETER EXPERIMENT FOR INVESTIGATION OF THE PROMPT GAMMA RADIATION FROM FISSION FRAGMENT OF SPECIFIC MASS IN A TIME RANGE OF 10^{-9} SECONDS AFTER A NEUTRON-INDUCED FISSION. Horsch, F.; Piper, I. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Kernphysik). Aug 1969. 24p. (In German). Dep. CFSTI (U. S. Sales Only).

The special experimental difficulties which occur in the three-parameter experiment and its installation on the reactor are described, and the solutions to the difficulties are given. Instrumental characteristics, such as time pulse decrease or pile-up reduction in the silicon detector branch are described individually. The methods used for the evaluation of the data are summarized and illustrated on some measurement results. The prompt gamma spectra are measured as a function of the mass and the kinetic energy of the fission fragments in flight. (tr-auth)

25258 (RT/FI–(69)13) PROPORTIONAL COUNTER FOR MEASURING THE MULTIPLICATION FACTOR. Cervellati, R.; Marseguerra, M.; Monaci, P.; Porceddu, C. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 6 Mar 1969. 29p. (In Italian). Dep. CFSTI (U. S. Sales Only).

A type of proportional counter is described suitable for studying the dependence of the multiplication factor upon the gas mixture. (auth)

25259 (RT/FI–(69)38) CALCULATED PHOTOEFFICIENCIES AND ENERGY LOSS SPECTRA FOR 3" x 3", 5" x 5" AND 8" x 8" NaI(Tl) CRYSTALS AND FOR GAMMA RAYS UP TO 15 MeV. Giannini, M.; Pliva, P. R.; Ramorino, M. C. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 20 Sep 1969. 72p. Dep. CFSTI (U. S. Sales Only).

Photoefficiencies, peak-to-total ratios and energy loss spectra for 3" × 3", 5" × 5" and 8" × 8" NaI(Tl) crystals have been calculated. Results are given for a point source located at 10 cm and 30 cm from one crystal end, and for a broad parallel beam. The γ-ray energy ranges between 2 and 15 MeV. (auth)

25260 (UCRL–50007-69-3) HAZARDS CONTROL PROGRESS REPORT NO. 35, SEPTEMBER–DECEMBER 1969, WITH INDEX TO HAZARDS CONTROL PROGRESS REPORTS NO'S 33 THROUGH 35. (California Univ., Livermore. Lawrence Radiation Lab.). 50p. Dep. CFSTI.

Separate abstracts were prepared for 5 of the 9 papers presented. The remaining 4 papers were not within the scope of NSA. (W.H.K.)

For abstracts of individual papers see: 25164 and 25261–25264.

25261 (UCRL–50007-69-3, pp 1-9) DRUM SCANNER FOR THE MEASUREMENT OF ^{239}Pu CONTAMINATED WASTE. Tinney, J. F.; Hoeger, T. O.; Cate, J. L.; Taylor, R. D. (California Univ., Livermore. Lawrence Radiation Lab.).

The design, construction, and preliminary calibration of a sodium iodide scintillation gamma detector for plutonium-239 determination in drums containing contaminated waste are described. (W.H.K.)

25262 (UCRL–50007-69-3, pp 9-10) DIGITAL STACK EFFLUENT MONITOR. Greenhouse, N. A.; Silver, W. J.; Shapiro, E. G. (California Univ., Livermore. Lawrence Radiation Lab.).

The development and operation of a recycling generator–scaler system with an ionization chamber for monitoring stack effluents are described. (W.H.K.)

25263 (UCRL–50007-69-3, pp 11-17) INSTALLATION OF A GAS-TIGHT GRADED SHIELD LINER IN THE HAZARDS CONTROL WHOLE-BODY COUNTER. Lindeken, C. L.; Griffith, R. V.; Anderson, A. L.; Taylor, R. D. (California Univ., Livermore. Lawrence Radiation Lab.).

The installation and effectiveness of a graded shield liner for the underground whole-body counting room are described. The liner consisted of layers of lead, cadmium and copper. A marked improvement in background stability was observed. (W.H.K.)

25264 (UCRL–50007-69-3, pp 20-2) RESPONSE OF THE FIDLER DETECTOR TO LOW ENERGY NATURAL BACKGROUND RADIATION IN THE LIVERMORE VALLEY. Lindeken, C. L.; Hodgkins, D. J. (California Univ., Livermore. Lawrence Radiation Lab.).

Variations in the natural background radiation in the energy range from 10 to 100 keV were measured at selected sites in the Livermore Valley with a FIDLER detector (Field Instrument for Detection of Low Energy Radiation). The FIDLER detector is a thin-crystal thallium-activated sodium iodide scintillation detector. Response data are presented. (W.H.K.)

25265 (UCRL–72108) Ge CRYSTAL GROWTH AND EVALUATION AS Ge(Li) DETECTOR MATERIAL. Wichner, R.; Armantrout, G. A.; Brown, T. G. (California Univ., Livermore. Lawrence Radiation Lab.). Mar 1970. 13p. (CONF-700301–7). Dep. CFSTI.

From 12th Scintillation and Semiconductor Counter Symposium, Washington, D. C.

A comprehensive program of germanium single crystal growth and the evaluation of such material for use as Ge(Li) detectors is described. The effects of crystal growth parameters such as pull rate, cooling rate, crucible material, and atmosphere, among others, are analyzed by a number of techniques. These techniques include the standard etch-pit density, resistivity profile and minority carrier lifetime measurements as well as others which have been developed at this laboratory and have been shown to be extremely useful in characterizing the quality of single crystal germanium for Ge(Li) detectors. (auth)

25266 (UCRL-Trans-10447) APPARATUS WITH AN ADIABATIC γ-CALORIMETER FOR THE ABSOLUTE MEASUREMENT OF THE ACTIVITY OF γ-SOURCES. Kul'kova, L. P.; Khol'nova, E. A. Translated by A. M. A. Mincer for Univ. of California Lawrence Radiation Lab., Livermore, from Tr. Inst. Kom. Stand. Mer. Izmer. Prib. Sov. Min. SSSR; 89: 11-124(1967). 33p. Dep. CFSTI.

A description is given of the construction, principle of operation, and results of investigation of a new calorimetric apparatus UKG-3 with an adiabatic γ-calorimeter. The aim was to extend the scope of calorimetric measurements in the direction of low activities. The results showed that the apparatus can measure the activity of γ-sources beginning from 2×10^8 decays/sec, with an error of 3%. (auth)

25267 IONIZATION CURRENTS IN LIQUID IONIZATION CHAMBERS: LOW CONDUCTIVITY LIQUIDS. Gregg, E. C.; Bakale, G. (Case Western Reserve Univ., Cleveland). Contract W-31-109-ENG-78. Radiat. Res.; 42: 13-33(Apr 1970).

When an ion chamber containing a low conductivity liquid is exposed to a very short pulse of ionizing radiation ($\sim 10^{-7}$ seconds), the current in the external circuit is high during the pulse and then falls rapidly and nonexponentially towards zero. Further, the shape of the curve depends on both the delivered dose and the collecting field. A theoretical analysis of the liquid ion chamber under these conditions is given quantitating the effect of space charge and deriving expressions relating the observed current to the fundamental physical properties of the liquid. Experimental data for n-hexane are also shown covering six decades of both time and current for various collecting fields and incident doses for which data essentially establish the theoretical treatment. One-MeV electron beam irradiations were used ranging from 0.8 to 120 mA in pulse lengths from 10^{-8} to 10^{-6} second. Besides values for the recombination coefficient and other parameters, evidence is given of ionic charge multiplicity and free unattached electrons during the initial stages of the process. (auth)

25268 IMPROVEMENTS IN THE PREPARATION OF SEMICONDUCTOR NUCLEAR RADIATION DETECTORS. Siffert, Paul; Henck, Roland; Coche, Andre (to Centre National de la Recherche Scientifique). British Patent 1,188,418. 15 Apr 1970. Priority date 12 Apr 1967, France.

A diffusion method for preparation of n−i−p junction semiconductor detectors is described. (W.H.K.)

25269 USE OF WHOLE BODY COUNTER. Ackers, J. G. Tijdschr. Soc. Geneesk.; 47: 464-5(1969).

The principle of operation and construction of the RCN whole-body counter at Petten are discussed. The sensitivity for γ emitting nuclides is expressed as minimum detectable quantities. It is shown that for most nuclides this level is at the 0.001 μCi region, while maximum permissible single uptakes usually are of a mCi order. The use of this whole body counter for the purpose of health physics at the RCN is discussed. Of about 600 measurements per year (80% on a routine basis) in only 14% of the cases some internal contamination was demonstrated, mainly of ^{131}I and ^{203}Hg. Another method for routine counting is considered. (Excerpta Med.)

25270 SOME TESTS ON THE CONSISTENCY OF THE PERFORMANCE OF SIX PRECISION LONG COUNTERS INTENDED AS SECONDARY STANDARDS FOR THE MEASUREMENT OF FAST NEUTRON FLUX DENSITIES. Marshall, T. O. (Radiological Protection Service, Sutton, Eng.). Health Phys.; 18: 427-9 (Apr 1970).

Six precision long counters manufactured in the U. K. to the design of Pangher and Nichols were tested to determine the suitability of the counter as a standard for fast neutron flux density measurements. The manufacture was subject to acceptance testing involving inspection of the dimensions of the individual parts and radiological tests. These latter tests involving measurement with Am-Be and Sb-Be neutron sources are described and the results tabulated. The results confirmed the original work in showing that the counters had sensitivities to the same source of neutrons which did not differ by more than ±1% and that a total spread in sensitivity of the BF_3 tubes was 1.8%. The tests support the use of precision long counters as a standard instrument for fast neutron flux density measurements. (UK)

25271 PORTABLE AREA MONITOR FOR GAMMA RAYS. Jones, A. R. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Health Phys.; 18: 333-7(Apr 1970).

The purpose, design and performance of a portable area monitor is described. It is light enough to be used while being carried by a moving worker. When it is no longer necessary to move about, the monitor can be set down and connected to line power as well as remote recording and alarm facilities. It covers a range of dose rates from 1 mrad/hr to 10 rad/hr on a single logarithmic scale. The statistical precision is constant (10% standard deviation) over the whole scale but the speed of response is proportional to the dose rate. The monitor is equipped with its own visible and audible alarms which can be adjusted to alarm at any point of the meter scale. (auth) (UK)

25272 SENSITIVE AUTOMATIC COUNTING OF ALPHA PARTICLE TRACTS IN POLYMERS AND ITS APPLICATION IN DOSIMETRY. Johnson, D. R.; Boyett, R. H.; Becker, K. (Oak Ridge National Lab., Tenn.). Health Phys.; 18: 424-7(Apr 1970).

Following the successful use of the spark counting technique for automatically counting fission fragment tracks in polymer films, investigations have been carried out to extend this simple technique to counting alpha tracks in cellulose nitrate. The counter and the counting system are described. Details of the preparation of cellulose nitrate thin films are given. The use of the technique for dosimetry of radon daughters in the uranium mining industry; for conventional autoradiography; for fast neutron dosimetry using (n,f), (n,alpha), and recoil reactions; as an imaging system for neutron radiography; and for neutron-induced autoradiography of fissile elements such as plutonium and uranium is discussed. (UK)

25273 EXPERIENCE WITH BORON-LOADED NUCLEAR TRACK PLATES AS DETECTOR ELEMENTS FOR SPHERICAL MODERATOR TYPE NEUTRON MONITORS. Shapiro, J.; Smith, D. G.; Iannini, J. (Harvard Univ., Cambridge, Mass.). Health Phys.; 18: 418-24(Apr 1970).

A simple, sensitive, and inexpensive neutron monitor using boron-loaded nuclear track plates as detector elements and water as a spherical moderator is described. Details of the assembly of the dosimeter and of the processing and counting techniques used are given. The relative response found with a series of different diameter spheres is discussed. The experience obtained with the system used for environmental monitoring is described. This method is recommended for environmental neutron monitoring in mixed gamma fields of less than a few roentgens. Trained scanners are essential. (UK)

25274 PORTABLE ELECTRONIC SYSTEM EQUIPPED WITH AN IONIZATION CHAMBER FILLED WITH A LIQUID EQUIVALENT TO THE BIOLOGICAL TISSUE. Blanc, Daniel (Univ., Toulouse); Mathieu, Jacques; Bouet, Joseph; Prigent, Raymond. Health Phys.; 18: 432-4(Apr 1970).

The portable instrument described incorporates a beryllium electrode ionization chamber of which there are two sizes and either of which can be filled with tissue-equivalent liquid or a more sensitive liquid. The preamplifier is connected via a 50m cable to the main equipment consisting of an amplifier, galvanometer and 5 kV HV supply. Readings can be obtained for the dose rate or integrated absorbed dose. (UK)

25275 LITHIUM-DRIFTED SILICON DETECTOR SPECTROMETER WITH MULTIPLE USES. Enulescu, Al. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 14: 1179-89 (1969).

A Si(Li) spectrometer with multiple uses is described. The components, i.e., cryostat, cooling and vacuum systems, air lock, detector bias set and extraction and processing signal units are discussed. The different uses of this spectrometer, β, e^-, γ, $e^- - e^-$, $\beta - \gamma$, $e^- - \gamma$ are reviewed. Some results concerning cooling time determination and energy spectra obtained with commercially manufactured Si(Li) detectors are described. (auth)

25276 ANALYSIS OF DETECTION BY NEON HODOSCOPE. Jatczak, Jerzy (Univ. of Lodz, Poland). Nukleonika; 14: 1047-60(1969).

The detection of EAS particles by an array of hodoscoped Conversi detectors (neon flash-tubes) is analyzed. The average number of Conversi detectors hit by a single particle is found as a function of the angle the direction of the particle makes with the vertical. The probability of the particle causing detectors to flash is calculated as a function of that angle. The relation between the layer efficiency of the hodoscope and the zenith angle of the shower axis is derived. (auth)

25277 SCINTILLATION PULSE SHAPES OF ANTHRACENE SINGLE CRYSTALS IN NANOSECOND REGION. II. DIFFERENCE BETWEEN SCINTILLATION AND FLUORESCENCE PULSES. Owaki, Shigehiro; Kimura, Yoshitake; Kawanishi, Masaharu (Osaka Univ.). J. Phys. Soc. Jap.; 28: 1251-4(May 1970).

The accurate pulse shapes of the luminescence of anthracene single crystal in the time region of about 50 nsec from the rise-portion of pulse excited by uv light pulses, α-, β-particles and γ-rays were obtained. The pure decay constants of scintillations excited by high energy radiation, and of fluorescence by uv light pulses were determined to be (10 ± 1) nsec and (6.5 ± 0.5) nsec respectively without the self-absorption effect. The differences of decay constants and rise times between scintillation and fluorescence pulses were discussed on the basis of the fact that the life time of ions generated in anthracene crystals by high energy radiation is longer than that of the lowest singlet excitons. (auth)

25278 THE PREAMPLIFIED SPIRALTRON ELECTRON MULTIPLIER. Wolber, W. G. (Bendix Research Labs., Southfield, Mich.); Klettke, B. D.; Graves, P. W. Rev. Sci. Instrum.; 41: 724-8(May 1970).

A new channel electron multiplier having a simple straight line geometry that preserves the desirable pulse characteristics of the curved channel is described. The channel consists of a Spiraltron element (a length of glass tubing twisted about its central axis) preceded by a preamplifier element to increase the geometrical open area ratio of the device. Experimental results have indicated that the new multiplier, which has a maximum operating voltage of 5.5 kV, an input aperture 1 cm in diameter, and a dark pulse count rate of <0.5 count/sec, is comparable to or better than the best curved channels in all properties except FWHM. (auth)

25279 DRIVING WAVEFORMS AND TIMING IN PULSE HEIGHT ANALYSERS. Vojinovic, Mirko. Bull. Boris Kidric Inst. Nucl. Sci., Electron.; 19: No. 2, 9-18(Aug 1968).

Radiation detector output waveforms are analyzed and the influence of the amplifier characteristics on them examined. Relations between the admissible input waveforms and timing conditions in pulse height analysers are given, enabling proper operation without unnecessary reduction of the operating speed. (auth)

25280 PULSE COUNTING METHOD USING CHANNEL MULTIPLIER. Nishizawa, Kazushige; Narisada, Kaoru (Osaka Univ.). Shitsuryo Bunseki; 17: 854-9(Dec 1969).

The behavior of Bendix Channeltron C. E. M. 4028, a new type electron multiplier, has been investigated for the multiplier gain, pulse height distribution, etc. The multiplier gain exceeded 10^8 and full width at half-maximum of pulse height distribution was 50% in a pulse saturated mode for heavy ions with low energy. The C. E. M. 4028 was confirmed to be well applicable to pulse counting which was not only important in the isotopic microanalysis of radioactive material, but also in other kinds of applications. The isotopic abundance ratio of mercury was measured by the mass-spectrometer with this detector system. The results were well coincided with the well known data in literature. (auth) (NSA of Japan)

25281 WHOLE-BODY-RADIATION COUNTER WITH MEANS FOR CONTROLLING THE SCANNING VELOCITY. Roesch, William C. (to U. S. Atomic Energy Commission). U. S. Patent 3,501,634. 17 Mar 1970. Filed 6 Mar 1968.

A whole-body-radiation counter which includes radiation-counting means and specimen-support means movable with respect to the counting means to provide a whole-body-radiation scan of radionuclides within a specimen mounted on the support means is described. A resistor-capacitor combination generates a signal decaying in amplitude proportional to $e^{-\lambda t}$, where e is the natural logarithm, λ = .693 divided by the half-life of the radionuclide being measured and t = time measured from a predetermined reference time. A stepping motor responsive to this signal drives the specimen-support means. (AEC)

25282 RELAY-MEASUREMENT UNIT BASED ON A SEMICONDUCTOR DETECTOR FOR INDICATING LARGE GAMMA-RAY FLUXES. Gorenburg, L. S.; Pogrebnoi, Yu. P.; Sorkin, M. Yu. At. Energ. (USSR); 27: 562-3(Dec 1969). (In Russian).

The use of a polycrystalline cadmium sulfide detector to determine gamma dose rates of 200 to 700 r/hr in a reactor is described. The cadmium sulfide sensing element can operate over changes in radiation levels of 2 to 3 orders of magnitude. It has a low power voltage, it is small in size, and it is stable under the effects of vibration. Under irradiation the cadmium sulfide sensing element gives off light pulses which decreases its resistance and leads to an increase in current which is proportional to the gamma radiation dose. A ^{60}Co source was used to calibrate the element. The instrument was used to take gamma radiation readings along the length of a fuel element. The operation of the instrument was steady and reliable. (TTT)

25283 DEVELOPMENTS AND APPLICATION OF A NEW TYPE TEST CHART FOR RADIOGRAPHIC IMAGE QUALITY MEASUREMENT. Tamoto, Yusaku; Kubota, Eitaro (Konishiroku Photographic Industries Co., Tokyo). Sakura X-Rei Shashin Kenkyu; 20: No. 6, 18-20(Nov 1969). (In Japanese).

The quality of a new type test chart, manufactured for trial and designated as the KR-chart, was examined in comparison with that of the existing test chart designated as the SR-chart, and unexpectedly good results were obtained. One of the KR-charts manufactured for trial was made by piling aluminum foil and lead foil alternately, and has a pattern that the elements having different spatial frequency (ν) are arranged symmetrically in the order of ν = 5.0, 3.0, 2.5, 2.0, 1.6, 1.25, 1.0, 0.85, and 0.0 lines/mm, placing an element having ν = 10 lines/mm in the center. The KR-chart and the SR-chart were exposed to X-ray simultaneously and their radiographs were taken. Then, the density of the radiographic image was measured. The result showed that the SR-chart was suitable for half contrast or low contrast use and the KR-chart was adequate for high contrast use. As a special application, the KR-chart was utilized as a simulator of lesion. It was inserted into several sites of trunk phantom and its radiograph was taken. Then the sharpness of the radiographic image was studied. The result showed that the change of radiographic image quality, which corresponded to the change of distance from the lesion to film, could be measured quantitatively. (NSA of Japan)

25284 REGISTRATION OF FISSION PRODUCTS WITH A ZnS(Ag) DETECTOR. Keirim-Markus, I. B.; Kraitor, S. N. At. Energ. (USSR); 27: 565-6(Dec 1969). (In Russian).

Fission product detectors have been made with dispersed mixtures of uranyl nitrate, uranyl acetate or thorium nitrate and zinc sulfide (silver-activated) having an optimum thickness of approximately 200 mg/cm^2 and a weight ratio of salt to luminophor of 1 : 6 for uranium and 1 : 3 for thorium. It would be desirable to have thinner layers of more finely dispersed materials. A ZnS luminophor having an average grain size of 1 to 2 microns was investigated at layer thicknesses of 3 to 20 mg/cm^2. The maximum amplitude of pulses from fission products, alpha particles, and secondary irradiation was determined as a function of luminophor thickness. Fission products show a maximum at a thickness of 3 mg/cm^2, alpha particles at 5 to 8 mg/cm^2, and secondary radiation at 20 mg/cm^2. Hence the FS-1 ZnS luminophor is the most suitable for counting fission fragments, since it has the smallest grain size and can continuously cover a surface at a thickness of 2 to 3 mg/cm^2. (TTT)

25285 RADIOISOTOPE SCAN DISPLAY WHICH CALCULATES THE SIGNIFICANCE OF A NORMAL SCAN. Dowsett, D. J. (Atkinson Morley's Hospital, Wimbledon, Eng.). pp 51-5 of Instrumentation in Medicine. London; World Medical Electronics (1967).

From 2nd European Symposium on Medical Electronics, London, England. See CONF-670339.

Difficulties were experienced in correct visual interpretation of low density photo-scan readout from a Picker Magna Scanner, Mk 2, with a 3″ crystal used for brain scanning. A numerical assessment of the dot scan made by evaluating the difference between the patient's and a normal dot scan in terms of statistical significance was found effective but too slow for clinical work. An attempt to automate these manual calculations is described. (UK)

25286 LARGE AREA WHOLE-BODY COUNTERS FOR CLINICAL APPLICATIONS. Barnaby, C. F.; Jasani, B.; Smith, T. (University Coll. Hospital, London). pp 56-9 of Instrumentation in Medicine. London; World Medical Electronics (1967).

From 2nd European Symposium on Medical Electronics, London, England. See CONF-670339.

The essential requirements of whole-body counters for routine clinical work are reviewed. The choice of counting system, the design of the counter, performance criteria, and the electronic equipment required are considered. It is concluded that whole-body counters using a liquid scintillator based on medicinal paraffin are particularly suitable. (UK)

25287 CONTINUOUS-DYNODE ELECTRON MULTIPLIER DETECTORS USED WITH A ONE- (OR TWO-) DIMENSIONAL VACUUM SCANNER FOR DETECTION OF TRITIUM AND RADIOCARBON IN THIN-LAYER RADIOCHROMATOGRAPHY. Prydz, S.; Meloe, B.; Koren, J. F. (Univ. of Oslo). pp 159-64 of Chromatographie Electrophorese. Bruxelles; Presses Academiques Europeennes (1969).

From 5th International Symposium on Chromatography and Electrophoresis, Brussels, Belgium. See CONF-680971.

A step scanner for measurement of one- or two-dimensional distributions of radionuclides in thin-layer chromatography (TLC) has been constructed and tested. Different versions of miniaturized channel electrol multipliers (to be operated in vacuum) have been applied as detectors. A description is given of the principle of operation, the vacuum step scanner, and the method of data presentation. Counter tests have been performed with calibrated standards of ^{3}H and ^{14}C in the form of polymethylmethacrylate pieces with known electron fluxes (numbers of emitted electrons per second per cm^2). Several TL media have been used with applicated spots of ^{3}H or ^{14}C glucose solutions. Upon drying, spots of activities down to 5 nCi could easily be detected (spot area ca. 0.5 cm^2). A resolution of 1 mm can be achieved in the one-dimensional scans. (auth)

25288 GAS-LIQUID RADIOCHROMATOGRAPHY USING TWO PROPORTIONAL COUNTERS INSTALLED IN SERIES. Lelotte, H.; Furnelle, J.; Winand, J.; Christophe, J. (Univ. Libre, Brussels). pp 176-84 of Chromatographie Electrophorese. Bruxelles; Presses Academiques Europeennes (1969). (In French).

From 5th International Symposium on Chromatography and Electrophoresis, Brussels, Belgium. See CONF-680971.

In order to measure continuously the β radiations of chromatographic effluents after pyrolysis, anthracene scintillation crystals were rejected in preference for proportional counters, so as to work at room temperature. The radiochromatographic method adopted used two proportional counters installed in series. This assembly gives a good resolution of the carbon-14 activity of methyl esters of fatty acids with close retention times (16 : 0 and 16 : 1, for example). Radioactivity as low as 0.15 mμ curies in 16 : 0 can be detected. The material and methods are described and illustrated by a flow diagram. The linearity of response and limits of sensitivity as a function of the retention time were determined. (J.S.R.)

25289 SOME PROPERTIES OF SILICA USED IN SCINTILLATING GELS. Germai, G. (Univ., Liege). Radiochem. Radioanal. Lett.; 3: 281-5(24 Apr 1970).

The quality of low level counting by means of Aerosil scintillating gels is well known. The experiments described show that this is very probably due to the fact that Aerosil acts like a quencher and an internal reflector. The quenching law applying to liquid scintillators containing an impurity is deduced theoretically. (auth)

25290 MATERIALS PROBLEMS IN LITHIUM-DRIFTED GERMANIUM RADIATION DETECTORS. Jindal, G. R.; Faust, J. W. Jr. (Pennsylvania State Univ., University Park). J. Appl. Phys.; 41: 2106-09(Apr 1970).

Some materials problems involved in the preparation of lithium-drifted germanium gamma-ray detectors are described. A preliminary study shows some decided differences between the characteristics of the original starting material and the characteristics of the material after various fabrication procedures. (auth)

25291 METHOD FOR BURN-UP CORRECTION FOR NEUTRON DETECTORS. Endler, A. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie; 13: 45-7(Feb 1970). (In German)

A method for correction of the burn-up of neutron-sensitive material and the sensitivity loss of neutron detectors connected with this is described. For this purpose the detector signals will be added and then used for correction of the measured value. The connection between indicated and corrected measuring value is given. (auth)

Nuclear Spectroscopic Instrumentation

Refer also to abstracts 25306, 25336, 26559, 26641, and 26652.

25292 (CEA-N-1158) APPLICATIONS IN RADIOPROTECTION OF α AND β SPECTROMETRY BY SEMICONDUCTORS. Descours, Solange; De Choudens, Henri (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Mar 1970 48p. (In French). Dep. CFSTI (U. S. Sales Only).

The possible applications of semiconductor spectrometers in radioprotection were studied. Several types of detectors were tested in α-ray spectrometry and the largest one was chosen. Its sensitivity is higher in spite of its low resolving power. Alpha peaks separated by at least 260 keV can be identified on an atmospheric filter. Pu can be separated on the same filter from the solid daughters of radon. The separation of the uranium peaks from those of plutonium is made possible. In β spectrometry, the maximum energy of a β emitter, when alone or when coupled with another one with a very different level of energy, can be determined. In a sample possessing three well-known β emitters, the activity of each component (even when one of them has an activity of 1 per cent of the others) can be measured quantitatively. The complex spectrum has to be analyzed by a computer program. (France)

25293 (FRL-4) GAMMA-SPECTROMETRIC ANALYSIS OF ENVIRONMENTAL MATERIALS. Dutton, J. W. R. (Ministry of Agriculture, Fisheries and Food, Lowestoft (England). Fisheries Radiobiological Lab.). Nov 1969. 18p. Dep. CFSTI (U. S. Sales Only).

Gamma spectra analysis of aquatic environmental materials for determining the extent of environmental contamination around fuel reprocessing and reactor sites is discussed. Gamma spectrometer design, spectra unfolding, and calibration are discussed; and analysis procedures are described including sample preparation, counting, tape heading, and computer calculations. Typical gamma spectra are included. (W.H.K.)

25294 (KURRI-TR-61) MEASUREMENT OF FAST NEUTRON SPECTRUM WITH THRESHOLD DETECTORS. Kimura, Itsuro; Kobayashi, Katsuhei; Shibata, Toshikazu (Kyoto Univ. (Japan). Research Reactor Inst.). 1969. 27p. (In Japanese). Dep. CFSTI (U. S. Sales Only).

By using seven threshold reactions, the fast neutron spectrum in the core of the Kyoto University Reactor, KUR, was measured. The result shows that the shape of the spectrum is approximately the same as that of fission neutrons. Therefore, the average cross sections of nine threshold reactions (^{46}Ti(n,p)^{46}Sc, ^{47}Ti(n,p)^{47}Sc, ^{48}Ti(n,p)^{48}Sc, ^{28}Si(n,p)^{28}Al, ^{29}Si(n,p)^{29}Al, ^{30}Si(n,α)^{27}Mg, ^{64}Zn(n,p)^{64}Cu, ^{204}Pb(n,n')^{204m}Pb, and ^{204}Pb(n,2n)^{203}Pb) for this quasi-fission spectrum in KUR have been measured. A Ge(Li) counter was mainly used for the measurement of gamma-rays from induced activities. (67 references) (auth)

25295 (KURRI-TR-67) MEASUREMENT OF FAST NEUTRON SPECTRUM WITH ^{6}Li AND ^{3}He SANDWICH COUNTERS. Kimura, Itsuro; Hayashi, Shu A.; Kobayashi, Katsuhei; Ishihara, Shinji; Shibata, Toshikazu (Kyoto Univ. (Japan). Research Reactor Inst.). [1969]. 42p. (In Japanese). Dep. CFSTI (U. S. Sales Only).

The characteristics, such as neutron detection efficiency and energy resolution, of both a ^{6}Li sandwich and a ^{3}He sandwich counter were calculated theoretically. These counters were manufactured and tested. The experimental results were compared with the theoretical values. Both energy resolution results agreed satisfactorily. Although direct testing of the detection efficiencies of these counters could not be done, it was shown that the relative values of the detection efficiencies were almost independent of either method of calculation or cross section data. After testing pile-up by gamma rays, linearity of output pulse versus neutron energy, evaluation of background, effect of pressure of ^{3}He gas etc., these counters were used to measure fast neutron spectra at the beam port of an experimental tube of KUR. The results showed that the spectrum was close to the fission neutron spectrum. The spectrum for the ordinary core configuration which had graphite reflectors between the head of the tube and the fuel showed a remarkable dip at 3.5 MeV. At least, the spectra of the neutrons after passing through graphite, lead, iron and heavy concrete were measured with the ^{6}Li sandwich counter and the results were compared with the calculated uncollided spectra. (auth)

25296 LINEAR VELOCITY TYPE MOESSBUAER SPECTROMETER. Ruscu, R. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 14: 1171-7(1969).

A Moessbauer spectrometer with a linear velocity vs. time dependence is described. The source is moved by an electrodynamical vibrator connected to a circuit with negative feedback. The maximum velocity can be stepwisely modified in the 0.1 mm/s to 1 cm/s range. A resolution of 0.205 ± 0.01 mm/s was obtained with a natrium nitropruside—$Na_2[Fe(CN)_5NO] \cdot 2H_2O$-powder absorber, as well as a linearity of better than 1% checked with αFe_2O_3. (auth)

25297 IMPROVEMENTS IN OR RELATING TO LIQUID SCINTILLATION SPECTROMETRY. (to Packard Instrument Co. Inc.). British Patent 1,185,071. 18 Mar 1970. Priority date 11 Apr 1966, United States.

The equipment and method for liquid scintillation spectral analysis of radioisotopes are described. Improved external radiation standardization equipment and procedures are presented. (W.H.K.)

High Energy Physics Instrumentation

Refer also to abstract 26571.

25298 (INFN/AE-69/7) THE CERN-TRIESTE MAGNETOSTRICTIVE WIRE SPARK CHAMBERS SYSTEM FOR THE LOW-ENERGY πd AND πp SCATTERING EXPERIMENT AT THE CERN PHOTOSYNCHROTRON. Bradamante, F.; Conetti, S.; Fidecaro, G.; Fidecaro, M.; Giorgi, M.; Penzo, A.; Piemontese, L.; Sauli, F.; Schiavon, P.; Vascotto, A. (Istituto Nazionale di Fisica Nucleare, Trieste (Italy). European Organization for Nuclear Research, Geneva (Switzerland)). 1 Jun 1969. 94p. Dep. CFSTI (U. S. Sales Only).

The system of wire spark chambers with magnetostrictive readout which has been used in a low energy elastic scattering experiment at the CERN proton synchrotron is described. Details of the construction of the chambers, of the electronic readout, of the data acquisition system, and of the reconstruction program are given. Finally the precision attained in the experiment is discussed as a function of the various parameters of the system. (auth)

25299 (PITHA-30) A WIRE SPARK CHAMBER SPECTROMETER FOR ANALYSIS OF THE DECAY OF NEUTRAL K MESONS. Lehnart, N. (Technische Hochschule, Aachen (West Germany). Physikalisches Institut (III)). May 1969. 147p. (In German). Dep. CFSTI (U. S. Sales Only).

Thesis.

The mass difference between K_L^0 and K_S^0 was measured in interference experiments and the phase of the CP-violated amplitude $\eta_{\pm}$ was determined. A digitalized wire chamber was used. The construction and properties of this chamber are described in detail. The experimental results are compared with the data of the superweak interaction model. The results are satisfactory. (J.S.R.)

25300 (RHEL/R-190) COMPUTER GRAPHICS PATCHING OF HPD FAILED EVENTS. Scott, D. B. (Rutherford High Energy Lab., Chilton (England)). Jan 1970. 24p. Dep. CFSTI (U. S. Sales Only).

A system of programs is described for the rescue of bubble chamber events which, having been measured on the automatic Hough Powell Device, subsequently fail in the geometrical reconstruction of the event from its three views. Selected regions of the events are displayed on a computer-controlled CRT, and faults in the pattern recognition processes of track-finding repaired by an operator using a light-pen. The results are subsequently merged with the good events onto a new geometry-input magnetic tape. (auth)

25301 INSENSITIVITY TO COSMIC RAYS OF THE GRAVITY RADIATION DETECTOR. Ezrow, D. H.; Wall, N. S.; Weber, J.; Yodh, G. B. (Univ. of Maryland, College Park). Phys. Rev. Lett.; 24: 945-7(27 Apr 1970).

A search for coincidences between cosmic-ray shower signals in a large scintillation counter and gravitational-radiation detector signals indicates that the gravitational radiation detector does not produce a signal when hit by showers of particle density of the order of 100 particles/m^2. (auth)

25302 RAPID CHARGING SYSTEM FOR SPARK CHAMBER PULSERS. Benbrook, James R. (Univ. of Washington, Seattle). Rev. Sci. Instrum.; 41: 687-8(May 1970).

A solid state switch for use in spark chamber pulsing systems has been developed which permits delaying the recharging of the spark chamber driving capacitor and thus allows high charging current and rapid recycling. This system has been tested in a recent Bevatron experiment at the Lawrence Radiation Laboratory. (auth)

25303 FLYING IMAGE DIGITIZER UTILIZING MEANS FOR SWEEPING THE FOCUSED IMAGE PAST A LINEAR ARRAY OF PHOTODETECTORS AND GRATING MEANS FOR LOCATING RECORDED DATA IN SPACE AND TIME. Kawaguti, Minato (to U. S. Atomic Energy Commission). U. S. Patent 3,501,643. 17 Mar 1970. Filed 10 Oct 1968.

A flying image digitizer is described for bubble chamber film having means for sweeping the film past a plurality of photosensors for detecting the light and dark portions of the film corresponding to the record thereon of nuclear particle tracks. Grating means are provided for locating in time and space the light and dark portions of the film detected whereby electronic pulses are produced corresponding to the detected portions for recording in a computer. (AEC)

Radiation Dosimeters

Refer also to abstracts 25274, 25478, and 25480.

25304 (CEA-R-3964) A STUDY OF THE PARAMETERS OF DOSIMETRY AND THEIR EXPRESSION AT ELEMENTARY INTERACTION LEVEL. Abillon, Eliane; Delattre, Pierre; Naudet, Gilbert; Senaux, Robert (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Mar 1970. 185p. (In French). Dep. CFSTI (U. S. Sales Only).

It is shown how the parameters currently used in dosimetry can be expressed at an elementary interaction level. The main expressions and parameters of dosimetry in its most general meaning, (from conventional dosimetry down to microdosimetry) are recapitulated and discussed. For all the involved branches, the action of a radiation on a medium is typically based on energy transfer. The elementary interactions are those occurring between the radiation and the constituent elements of the medium (atoms, ions, radicals, ...). Thus the action of a radiation is converted into a series of elementary events: ionizations, excitations, electronic recombinations and so on. Each of these events is defined as the product of a cross section by a flux. It is then shown that in any case the reference parameters needed to account for the evolution of a system exposed to radiation are the particle spectra and the interaction cross-sections. (France)

25305 (CNEA-242) STUDY OF THE EFFECTS OF ELECTROMAGNETIC RADIATION ON THE SYSTEM CARBON TETRACHLORIDE–DITHIZONE AND ITS USE AS A DOSIMETER. Campa, J. Pahissa; Gabarain, R. V. A.; Hersocovich de Pahissa, M. H.; Suner, A. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1969. 15p. (In Spanish). Dep. CFSTI (U. S. Sales Only).

Carbon tetrachloride–dithizone solutions are proposed as dosimeter for electromagnetic radiations. Radiations cause a decrease of absorbance of these solutions at 615 mμ and increase in other zones of the spectrum. The sum of absorbances at 615 and 400 mμ is used as the dosimeter parameter. This sum has the advantage of no post irradiation phenomena, as found by other authors. The proposed dosimeter is quite independent of the dose rate, the photon energy, and the dithizone concentration. It was found at the lower limit of operation that 20 rads can be measured with 10% error. The upper limit of measurement depends on the dithizone concentration and stabilization time. In order to obtain higher sensitivity, optimal geometric conditions are stated. Studies have been made on the radiolysis of the solvent and the influence of different agents on it as well as the kinetics of the post irradiation phenomena. G of the reaction has also been determined. (auth)

25306 (DESY-70/5) NEUTRON DOSIMETRY IN THE ENERGY RANGE BETWEEN 10 AND 100 MeV. Tesch, K. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Feb 1970. 16p. Dep. CFSTI (U. S. Sales Only).

Two counting devices are described for neutron dosimetry in the energy range 10 to 100 MeV. The first is a scintillation counter with a liquid scintillator. The threshold is chosen in such a way that the correct response curve is given. Pulses from other particles are suppressed by pulse-shape discrimination. The second device is a simple extension of the multi-sphere method. Some results of dose measurements in the mentioned energy range are briefly described. (auth)

25307 (SLAC-PUB-731) AN IMPROVED TLD READER. Svensson, G. K.; McCall, R. C.; Babcock, G. L. (Stanford Linear Accelerator Center, Calif.). Apr 1970. 21p. (CONF-700505-1). Dep. CFSTI.

From 2nd Congress of the International Radiation Protection Association, Brighton, England.

Several improvements have been made in a TLD reader using the Conrad readout geometry. The major improvement is a heating system which utilizes a lead sulfide cell as a temperature sensor. The heating element is heated to a preselected temperature in 3 seconds and that temperature is maintained until readout is complete. The reader has a solid state electrometer and digital readout. Zero drift is virtually nonexistent. About 600 ^{7}LiF loose powder dosimeters have been analyzed in order to establish the readout system's optimum working conditions. For an absorbed dose of ≤0.1 rad the readout temperature is not critical as long as it is above or equal to 240°C. For higher doses, the best precision is being achieved at a readout temperature between 280°C and 320°C. An analysis is made of the causes of the observed standard deviation (0.6% at 10^2 rad and 0.7% at 0.3 rad), including contributing errors from thermal treatment of ^{7}LiF, background variation and the readout system. In high precision TLD work (e.g. 0.6% S.D.), the readout system contributes a significant but not dominant error. Teflon dosimeters are used for personnel dosimetry at SLAC. The readout cycle for them is 260°C for 15 seconds. This constant temperature cycle prevents the teflon discs from being damaged. (auth)

25308 (UR-49-1272) THE 14-MeV NEUTRON RESPONSE OF SEVERAL SPECIAL THERMOLUMINESCENT DOSIMETER PHOSPHORS. Kilian, John Philip (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). 1970. 54p. Dep. CFSTI.

Thesis.

Studies were made of the response of various thermoluminescent compounds to low exposure levels of both ^{60}Co gamma and 14 MeV neutron radiation. Included in this consideration were CaF_2 : Mn : Na : U, CaF_2 : Mn : U, $CaSO_4$: Mn : Na : U, $CaSO_4$: Dy, and $CaSO_4$: Dy : Gd. The thermoluminescent phosphor ^{7}LiF was also considered for comparison purposes. In general, the two calcium fluoride compounds were relatively insensitive to both neutron and gamma radiation. The calcium sulfate compounds were very responsive to gamma radiation with $CaSO_4$: Mn : Na : U being the most sensitive followed by $CaSO_4$: Dy and $CaSO_4$: Dy : Ga. The ratio of phosphor response per rad of 14 MeV neutrons to phosphor response per R of ^{60}Co gamma radiation exposure was found to be 0.281 for $CaSO_4$: Dy and $CaSO_4$: Mn : Na : U in stainless steel. The neutron to gamma response ratios for $CaSO_4$: Dy : Gd and for CaF_2 : Mn : U were somewhat less with CaF_2 : Mn : Na : U showing no useful neutron response. The exposure of $CaSO_4$: Dy in 0.108 inch thick polyethylene tubing caused an increase in the neutron to gamma response ratio by about a factor of 6 to 1.72. Because $CaSO_4$: Mn : Na : U fades very rapidly after exposure (36% in 8 hours), $CaSO_4$: Dy and $CaSO_4$: Dy : Gd were felt to be the most potentially useful dosimetric compounds tested. (auth)

25309 RADIATION INDUCED FADING AS A PERTURBATION IN DOSIMETER GLASSES. Graf, W.; Jeltsch, E. (Kernforschungsanlage, Juelich, Ger.). Atomkernenergie; 15: 83(1970). (In German).

For measurement of high γ doses, glass dosimeters of the type IM/6556 (Jena) can be used without correction up to 10^{9}r. Above this dose, significant fading occurs. This fading effects is strikingly enhanced during measurements in nuclear reactors due to the influence of neutrons. Therefore, glass dosimeters should be used in reactor measurements only up to 10^{8}r. At higher doses either corrections must be applied or other types of dosimeters should be used. (H.B.G.)

25310 DOSIMETRY OF ACCELERATED ELECTRON. PART 1. APPLICATION OF THE FRICKE DOSIMETER. Takano, Hiroyuki; Kawashima, Kogi; Hayakawa, Akira; Umeda, Keiji; Sato, Tomotaro (Food Research Inst., Tokyo). Shokuryo Kenkyujo Kenkyu Hokoku; No. 25, 1-3(Feb 1970). (In Japanese).

The Fricke dosimeter was applied to the Van de Graaff type electron accelerator (1 MeV. 150μA). All electrons were absorbed when the dosimeter solution was thicker than 3mm. G value was reduced to about half when the air-bubbled dosimeter was irradiated more than 3×10^6 erg/cm^2. However in the case of the oxygen-saturated dosimeter the reduction did not occur up to 6×10^6 erg/cm^2. The absorbed dose 0.65×10^6 erg/cm^2 of the Fricke dosimeter corresponded to 1.0×10^6 erg/cm^2 for the Faraday cage. The uniformity of irradiation field was examined by changing the scanner coil current. (auth) (NSA of Japan)

25311 PRINCIPLES OF THERMALLY STIMULATED EXOELECTRON EMISSION (TSEE) DOSIMETRY. Becker, K. (Oak Ridge National Lab., Tenn.). At. Energy Rev.; 8: 173-218(Mar 1970).

A review of the history and present status of exoelectron research is given, with emphasis on the more recent work of interest for the application of thermally stimulated exoelectron emission (TSEE) in dosimetry. The physical theory, types of exoelectron emitters, dosimetric properties of some exoelectron emitting materials, and the design and characteristics of dosimeters and TSEE readers are briefly described and their advantages and disadvantages summarized. 170 references are given. (auth)

25312 THERMOLUMINESCENCE PERSONNEL DOSIMETRY AT HANFORD. I. ^{7}LiF EXTREMITY AND NON-RADIATION WORKER DOSIMETERS. Kocher, L. F.; Kathren, R. L.; Endres, G. W. R. (Pacific Northwest Lab., Richland, Wash.). Health Phys.; 18: 311-17(Apr 1970).

A ring dosimeter utilizing ^{7}LiF–Teflon has been successfully used for hand dosimetry for more than a year. A non-radiation-worker dosimeter has been designed, utilizing two pieces of ^{7}LiF-teflon and provides the penetrating radiation exposure with a single readout regardless of energy. The dosimeter has a range of 40 mR to more than 10^5 R, and can also be used to estimate the dose from non-penetrating radiations or the effective energy of a photon exposure below about 100 keV. (auth) (UK)

25313 LIGHT SOURCE FOR TESTING THERMOLUMINESCENT DOSIMETER READERS. Robertson, M. K. (National Radiation Lab., Christchurch, N. Z.). Health Phys.; 18: 440-1 (Apr 1970).

With an internal light source for testing a T. L. D. reader, a downward drift of the calibration of a batch of powder and a sharp rise following the change to a new heating planchet, was noted. This was attributed to the change of reflectivity of the heating planchet as it tarnishes. A method of partially overcoming this effect by the external use of a ^{90}Sr foil (1 μCi) pressed into heat-softened scintillation plastic is described. Use of the external light source reduces the requirement for reading TL dosimeters exposed to calibration doses and the use and design of a light source has much significance. (UK)

25314 ENERGY-SIZE DEPENDENCE OF THE RESPONSE OF THERMOLUMINESCENT DOSIMETERS TO PHOTON IRRADIATION. Chan, F. K.; Burlin, T. E. (Polytechnic, London). Health Phys.; 18: 325-32(1970).

The influence of the grain size and the photon energy on the light output of a thermoluminescent dosimeter is discussed. A recent cavity theory is applied to the problem and the response of lithium fluoride, calcium fluoride, calcium sulphate and lithium borate when in air or teflon have been calculated. The calculations cover grain sizes from 1 to 100 μ and photon energies from 0.01 to 0.60 MeV. Above 0.2 MeV the response of all these thermoluminescent dosimeters, whether in air or teflon is almost independent of both the grain size and the photon energy. (auth) (UK)

25315 DEVELOPMENT OF CALORIMETRIC RADIATION MEASUREMENTS IN THE IAEA LABORATORY. Nagl, J. Rev. Roum. Phys.; 14: 1093-8(1969).

The development at IAEA of calorimeters for the determination of total energy output from alpha and beta emitting sources and the development of calorimeters for the absolute measurement of absorbed dose in beams of high energy ionizing radiation are described. (W.H.K.)

25316 DISPERSION AND INTENSIFICATION OF PHOTOGRAPHIC DENSITY IN FILMS FOR GAMMA-RAYS FROM ^{60}Co. Kikuchi, Bunsei (Tokai Univ., Tokyo); Nakamura, Masamoto. Proc. Fac. Sci. Tokai Univ.; 4: 55-61(Mar 1969).

In order to improve photographic properties for radiation, the effect of metallic foils used for photographic intensification of the photographic density of X-ray films was studied. It was found that film sensitivity for gamma-rays from ^{60}Co, when an aluminum foil of 2.7×10^{-2} g/cm^2 in thickness was set in front of the X-ray film, increases by a factor of 1.2 that of a lead foil of 4.5×10^{-2} g/cm^2 in thickness. The error attributed to dispersion of photographic density is 4.7% for the general badge film, and 2.3% for the aluminum foil of 2.7×10^{-2} g/cm^2 in thickness. (auth) (NSA of Japan)

25317 THE RESPONSE OF THERMOLUMINESCENT DOSIMETRIC LITHIUM BORATES EQUIVALENT TO AIR, WATER, AND SOFT TISSUE AND OF LiF TLD-100 TO LOW ENERGY X-RAYS. Jayachandran, C. A. (Hammersmith Hospital, London). Phys. Med. Biol.; 15: 325-34(Apr 1970).

Calculations of response to mono-energetic photons show that lithium borates containing 0, 0.1%, 0.25%, and 0.34% of Mn are equivalent to soft tissue ($C_5H_{40}O_{18}N$), water ICRU muscle, and air, respectively. Results obtained with monochromatic and broad-spectrum x-rays of effective energies between 12 and 115 keV are in agreement with this finding. The monochromatic and broad-spectrum x-ray beams were also used to explore the discrepancies in response of LiF TLD–100 to low energy photons. Only small discrepancies were found which were attributed either to breadth of x-ray spectra or to additional absorbed dose due to scattered x-rays amounting to about 5% at 40 keV$_{eff}$. (auth) (UK)

25318 REVISED EVALUATION OF DOSE MEASUREMENTS OBTAINED BY A SIMPLE ADIABATIC CALORIMETER. Haltenbach, K.; Melkonyan, G. A.; Segler, E. (Institut fuer Reaktorphysik, Geesthacht, Ger.). Atomkernenergie; 14: 450(Nov-Dec 1969). (In German).

Dose measurements with an improved adiabatic calorimeter showed that the doses obtained in hydrocarbons and beryllium were about 10% higher than those obtained in aluminum. All samples were enclosed in a shield consisting of $AlMg_3$. Repetition of the measurements in a reactor proved that the aluminum values were the correct ones and that the hydrocarbon and beryllium values were increased by Compton electrons originating from the aluminum shielding due to the action of both fast and thermal neutrons which was much higher than expected. (H.B.G.)

Radiometric Instruments

Refer also to abstract 25332.

25319 (RISO-209) EQUIPMENT FOR DETERMINATION OF FUEL DENSITY IN FUEL PINS. Pedersen, W. Batsberg; Soerensen, O. Toft; Loevborg, L. (Danish Atomic Energy Commission, Risoe. Research Establishment). Nov 1969. 20p. Dep. CFSTI (U. S. Sales Only).

In connection with the Danish fuel element development program a densitometer using absorption of γ-radiation from a 200 mCi ^{137}Cs source was designed for measurements of the axial density distribution in fuel pins. A description is given of the principle of the method used, the equipment designed, and the tests carried out to determine the optimum measuring conditions. Some typical measurements of the density distribution in vibratory-compacted and pellet fuel pins are given. (Denmark)

25320 FUNDAMENTAL STUDIES ON RADIATION THICKNESS GAGE. IV. EXPERIMENTAL ANALYSIS OF STATISTIC ERRORS. Koyanagi, Takami; Aida, Kazuo (Niigata Univ., Nagaoka, Japan). Radioisotopes (Tokyo); 19: 123-8(Mar 1970). (In Japanese).

In a previous report, a formula for calculating the optimum radiation intensity for the detection of small changes in thickness was deduced. The formula includes some important factors such as the pulse height spectrum induced in the radiation detector and absorption characteristics of samples. These two factors are discussed briefly. The pulse height spectrum was investigated with β-rays from ^{90}Y–^{90}Sr. The β-rays were measured by silicon semiconductor radiation detectors of two different types, i.e., planer type and Li ion drift type. The reason why these two types were picked out is that these two solid state ionization detectors are considered to be similar to the gas ionization chamber. The results are as follows; the shape of spectrum is obviously deformed with the change in thickness of the depletion layer; and the mean value, standard deviation of the spectrum, and their ratio increase along with thickness of the depletion layer. In view of this result, it is hoped that the increasing air pressure in the ionization air chamber will decrease the statistical error of the output. The error, however, scarcely changes. When β-rays decrease by penetrating some absorber, the shape of spectrum changes little, and the same thing is observed with the ionization air chamber. As to the absorption characteristics, the experimental results shown in the part (I) of this study is used. The absorption curves develop various shapes. They can be classified into three types, and are approximated by each formula. Finally, the optimum intensity of radiation is calculated with some examples by putting these results into the formula. (auth)

25321 MEASUREMENT OF SELENIUM THICKNESS ON NICKEL SUBSTRATE USING BREMSSTRAHLUNG RADIATION. Salamida, D. P. (Xerox Corp., Rochester, N. Y.). Radiochem. Radioanal. Lett.; 3: 331-7(24 Apr 1970).

A $^3H/Zr$ bremsstrahlung source is used in place of the conventional X-ray tube for the X-ray fluorescence determination of the thickness of selenium coating on a nickel substrate with a relative error of 1.5%. The nickel X-ray fluorescence emanations are attenuated by the selenium coating, the attenuation being proportional to the Se thickness in the 0 to 80 micron ranges. The cost of the detection system is about $2,000, as compared to more exotic systems costing roughly $12,000. (auth)

Miscellaneous Instruments and Components

Refer also to abstracts 25364, 25502, 25519, and 25741.

25322 (DP-1217) A WATER-COOLED TWIN CALORIMETER FOR CURIUM SLUG ASSAY. McMillan, T. S. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Feb 1970. Contract AT(07-2)-1. 10p. Dep. CFSTI.

A water-cooled twin calorimeter of 20 watt capacity was developed to assay routinely the curium-244 content of aluminum-jacketed slugs. The instrument is operated with master-slave manipulators and requires approximately 45 minutes for a determination. Precision is within 2.5%. (auth)

25323 (GEMP-738) 1000 HOUR-2300°C THERMOCOUPLE STABILITY TESTS. Kuhlman, W. C.; Baxter, W. G. (General Electric Co., Cincinnati, Ohio. Nuclear Systems Programs). Oct 1969. Contract AT(40-1)-2847. 42p. Dep. CFSTI.

Two 1000-hour stability tests on small diameter (9 mil wires) thermocouples for measuring the centerline temperature of LMFBR fuel elements were conducted in a helium atmosphere at 2300°C. The first test used high purity hafnia (HfO_2) insulators and W versus W-25Re thermoelements. The second test employed high purity thoria (ThO_2) insulators and W-3Re versus W-25Re thermoelements. Both tests completed the 1000-hour test period at 2300°C. The W leg of the W, W-25Re thermocouple used with HfO_2, was found to be eroded and the W-25Re leg was found to have a higher W content. Both events influenced the emf output of the W, W-25Re thermocouple system. The W-3Re versus the W-25Re thermocouple with ThO_2 insulators was found to be more stable over the 1000-hour test period at 2300°C. It is believed that an improved furnace atmosphere (lower O_2 content) contributed to the improved performance of the second test. (auth)

25324 (NP-18202) ENERGY ANALYSING SYSTEM FOR IONS WITH ENERGIES BETWEEN 10 eV AND 15.2 keV. Rijnhuizen Report 69-57. Frederik, Josine E.; van der Heiden, T. C.; de Kluiver, H.; Nijsen-Vis, Adri (Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands). Instituut voor Plasma-Fysica). Dec 1969. 5p. Dep. CFSTI (U. S. Sales Only).

A 127° electrostatic analyser in combination with a Bendix magnetic resistance multiplier (M 306) has proved to be a reliable and sensitive device to detect ions from 10 eV to several keV. It is shown that there exists a simple relation between the ion flux at the entrance slit of the analyser and the registered number of pulses from the multiplier. Two examples are given. (auth)

25325 (ORNL-4514) MATHEMATICS DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING DECEMBER 31, 1969. Nestor, C. W. Jr. (comp. and ed.) (Oak Ridge National Lab., Tenn.). Apr 1970. Contract W-7405-eng-26. 134p. Dep. CFSTI.

An annual progress report is presented on mathematics and computer operations and mathematical statistics at ORNL during the period ending Dec. 31, 1969. Progress in mathematical research, computer applications, systems programming, and computer services is outlined and discussed. (W.H.K.)

25326 (ORNL-TM-2936) CONVERSION OF THE NUCLEAR DATA 130A PULSE-HEIGHT ANALYZER TO ASC II PAPER TAPE WITH MANUAL ENTRY FOR DATA IDENTIFICATION. Perdue, P. T.; Thorngate, J. H. (Oak Ridge National Lab., Tenn.). May 1970. Contract W-7405-eng-26. 15p. Dep. CFSTI.

A conversion for the Nuclear Data Model 130 pulse-height analyzer to punched paper tape in the American Standard Code for Information Interchange is given. This conversion provides for manual entry of data-set identification to allow full use of the computer for data reduction. The separate unit described does not change any of the original data interfaces provided by the manufacturer of this pulse-height analyzer. (auth)

25327 (ORNL-TM-2969) RADIOLOGICAL INSTRUMENT DESIGN INVESTIGATION FOR OCD, FEBRUARY 1969 TO JANUARY 1970. FINAL REPORT. Russell, J. A.; De Lorenzo, J. T.; Glass, F. M.; Kennedy, E. J.; Manning, F. W.; Wilson, H. N. (Oak Ridge National Lab., Tenn.). 22 Apr 1970. 29p. Dep. CFSTI.

Circuit and electronic component designs for OCD radiological instruments were studied in accordance with Interagency Agreement 40-170-69 between the Office of Civil Defense and the Atomic Energy Commission. Three transistorized dc-to-dc converter power supplies were designed and test results are reported. Two electrometer amplifiers were designed to operate on these converters, and their theoretical operating time on one standard D cell is 500-3000 hr. Other activities reported are an investigation of integrated circuit techniques and their compatibility with circuit design, radiation effects on semiconductors, and an evaluation of D cell kits and a comparison of their capabilities with commercially manufactured cells. (auth)

25328 (STI/DOC-10/103) IAEA LABORATORY ACTIVITIES. The IAEA Laboratories at Vienna and Seibersdorf; The International Laboratory of Marine Radioactivity at Monaco; The International Centre for Theoretical Physics at Trieste. Seventh Report. Technical Reports Series No. 103. (International Atomic Energy Agency, Vienna (Austria)). 1970. 111p. IAEA $3.00.

25329 (UCRL-72197) PLANAR OSCILLOSCOPE. Aaland, K.; Hsieh, E.; Westbrook, E. (California Univ., Livermore. Lawrence Radiation Lab.). Mar 1970. 15p. (CONF-700406-1). Dep. CFSTI.

From INTERMAG Conference, Washington, D. C.

Magnetic thin films can be used in various arrangements on cards to provide the equivalent of an oscilloscope-camera combination for the recording of a single-shot transient signal. The basic phenomenon used is the uniaxial isotropy property of magnetic thin films. The waveform of the signal is traced out as the boundary wall between two magnetic domains in a single film, or as the dividing line between two groups of domains in plated wires or in arrays of small areas of film. A sweeping field creates hard-axis magnetization. At the trailing edge of the sweeping field, the algebraic sum of the signal present at that instant, and a static gradient field, determine a neutral point above and below which the magnetization relaxes to opposite easy-axis polarities. Advantages of the recording method include: possibility of planar packaging, signal times from dc to nanoseconds, electronic readout and, from these latter two, the extension of memory oscilloscope technology to the nanosecond region. (auth)

25330 (UUIP-673) AUTOMATIC SYSTEM FOR ANGULAR CORRELATION MEASUREMENTS. Falk, F.; Linnfors, A.; Orre, B.; Thun, J. E. (Uppsala Univ. (Sweden). Inst. of Physics). Dec 1969. 21p. Dep. CFSTI (U. S. Sales Only).

A multipurpose angular correlation instrument with a versatile automatic controlling unit is described. The measuring program is executed by control of a punched card. This card is easily changed when a new measuring program is needed. A magnet allows the application of longitudinal and transverse magnetic fields up to 27 kG to the source. The temperature of the source may be varied. This instrument is suited for studies of both perturbed and unperturbed $\alpha-\gamma$ and $\gamma-\gamma$ angular correlations. For $\gamma-\gamma$ measurements the detector configurations are restricted. (auth) (Sweden)

25331 MASS SPECTROMETER ION SOURCE WITH HIGH YIELD. Swingler, D. L. (Chemical Research Labs., Victoria, Australia). J. Appl. Phys.; 41: 1496-9(15 Mar 1970).

An electron impact ion source suitable for use with a quadrupole mass filter is described. Ion formation occurs throughout a relatively large volume since no magnetic field collimation of the ionization electron stream is used. A sensitivity of 8 $Torr^{-1}$ was obtained for an ion energy of 50 eV rising to a constant sensitivity of 12 $Torr^{-1}$ for ion energies in excess of 250 eV. Trajectory tracing has been used to give some insight into the efficient operation of the ion source. (auth)

25332 ELEKTRONIKA W TECHNICE JADROWEJ. (Electronics in Nuclear Technology). Rzymkowski, Tadeusz; Trechcinski, Roman (eds.). Biblioteka Problemow Elektroniki i Telekomunikacji, No. 17. Warszawa; Wydawnictwa Komunikacji i Lacznosci (1968). 235p.

The collection starts with a review of the development and manufacturing of nuclear instruments in Polish scientific institutes, discussing also basic scientific problems, such as interaction of radiation with matter, α, β, and γ radiation, neutron radiation and electron capture. In the chapter on radiation detectors the problems involved in the design of ionization chambers, proportional counters, G–M counters are examined, mentioning also problems involved in the intensity measurements and the identification of radionuclides by means of γ spectroscopy and applications to health physics. A chapter is devoted to the amplification of weak currents, then the methods used for amplitude and time analysis— linear and multichannel analyzers and coincidence counters— are discussed. This is followed by a review of power supplies, discriminators, scalers and rate meters. The application of radioactive sources in industry is illustrated by describing techniques involving the measurement of thickness, density and chemical composition making use of such sources. After describing the instrumentation of nuclear reactors, the statistical and systematic errors in measurements are analyzed. (TTT)

25333 ON-LINE COMPUTER INTERFACING OF A DENSITOMETER FILM READER FOR MEASURING THE SIZE OF RADIOACTIVE COLLOID PARTICLES. Barclay, T. R.; Morris, A. C. Jr.; Hayes, R. L.; Carlton, J. E.; McDow, A. E. Jr. (Oak Ridge Associated Univs., Inc., Tenn.). Anal. Chem.; 42: 685-6 (May 1970).

Sedimentation-velocity methods have been used to measure particle sizes in developmental studies of radionuclide-labeled hydrous ferric oxide preparations. Such colloid preparations should have uniform particle sizes when used as medical scanning agents. Using Kraemer's method, the particle-size distributions were calculated from densitometer traces of ultracentrifuge cell-absorption films. These films are read with a Spinco Model R Analytrol that is fitted with a Beckman Microzone scanning attachment. Calculations made on the densitometric recordings from each film were done by hand, a laborious and time-consuming process. With the purchase of an IBM 1800 on-line computer, these calculations have been accelerated. Recently the computer was interfaced to automatically operate the Analytrol densitometer from a location 400 ft from the computer site. (auth)

25334 MEASUREMENT OF THE CLADDING TEMPERATURE OF REACTOR FUEL ELEMENTS. Gacsi, Lajos; Szaklajda, Laszlo. Atomtech. Tajek.; 12: 366-72(Nov-Dec 1969). (In Hungarian).

Performance of power and research reactors is strongly dependent on the maximum permissible cladding temperature of the fuel elements; the reliable and exact determination of this temperature is therefore of great practical importance. The general technique and problems encountered in such measurements are outlined. The thermocouples used must be able to retain their original characteristics after extended exposure to radiation; they must be corrosion resistant and must not initiate corrosive processes in the cladding, should not heat up independently of the cladding and should possess a sufficiently high heat conductivity coefficient and mechanical strength. The widely-used chromel-alumel and Ni-Nichrome thermocouples satisfy these requirements. Coaxial units are available commercially. The hot junction may be attached to the cladding of the fuel element by arc or flame welding. Faulty insulation, breaks and poor joints may be checked by electrical resistivity measurements, using high-impedance amplifiers or self-compensating potentiometers. The drift of these transistorized instruments should not exceed a few microvolts. The leaktightness of the measurement chain is determined by the usual helium testing; roentgenoscopic measurements are used to ascertain the position of the joints and the integrity of the cladding. (TTT)

25335 RADIAL DISK VELOCITY SELECTOR FOR MOLECULAR BEAMS. Cowley, L. T.; Fluendy, M. A. D.; Lawley, K. P. (Univ. of Edinburgh). Rev. Sci. Instrum.; 41: 666-7(May 1970).

A molecular beam velocity selector is reported in which the beam passes diametrically across a rotating slotted disk. Alignment is checked without reference to assumptions about the source velocity distribution. The selector is compact, easily constructed, and is mounted directly on the driving motor shaft. (auth)

25336 A METHOD FOR THE MEASUREMENT OF SCATTERING ANGLE IN AN ELECTRON BEAM SPECTROMETER. Cole, R. S.; Jennings, J. C. E. (Birkbeck Coll., London). Rev. Sci. Instrum.; 41: 711-12(May 1970).

The design procedure and the experimental details are given for the construction of a magnetic deflection system which has been used in an electron beam spectrometer to measure the angular distribution of the energy loss spectra of thin solid films. A collimated electron beam is deflected in such a way that it is incident on the specimen at the angle of scatter at which measurements are required. Electrons which emerge normally from the far side of the specimen are then momentum analyzed. The deflection was found to be proportional to current up to an angle of at least 0.04 rad. (auth)

25337 APPARATUS FOR MAGNETO-OPTICAL STUDIES OF MAGNETIC STRUCTURES AT LOW TEMPERATURES. Huebener, R. P.; Kampwirth, R. T.; Rowe, V. A. (Argonne National Lab., Ill.). Rev. Sci. Instrum.; 41: 722-3(May 1970).

A magneto-optical apparatus is described which is used for studies of magnetic structures at liquid helium temperatures. The system employs the high specific Faraday rotation of a mixture of EuS and EuF_2. A resolution of about 20 μ has been obtained. (auth)

25338 SINGLE-PHOTON TIME RESOLUTION OF PHOTOMULTIPLIERS WITH GALLIUM PHOSPHIDE FIRST DYNODES. Present, G.; Scarl, D. B. (Polytechnic Inst. of Brooklyn). Rev. Sci. Instrum.; 41: 771-2(May 1970).

In tests comparing the time response of photomultipliers with gallium phosphide first dynodes (RCA C31000F) and similar tubes with ordinary copper beryllium dynodes (RCA 8575), a 40% shorter single-photon resolving time was found for the GaP tubes. The single-photon resolving time was measured by exposing a pair of photomultipliers to bursts of simultaneous photons. The time spread of the photomultiplier output pulses that resulted from simultaneous single electrons leaving the photocathodes was measured with a time-to-height converter and a pulse height analyzer. (W.H.K.)

25339 CURRENT TRANSFORMER FOR LOW LEVEL MICROSECOND PULSES. Sarjeant, W. J.; Brannen, E. (Univ. of Western Ontario, London). Rev. Sci. Instrum.; 41: 775-6(May 1970).

The design and operating characteristics of two large-aperture (18 and 66 mm) current transformers for small amplitude, short duration pulses are described. The transformers described have been used for continuous monitoring of the electron beam from a racetrack microtron. (W.H.K.)

25340 PROBE UNIT FOR USE IN MEASURING THE CIRCUMFERENTIAL LENGTH OF THE INNER SURFACE OF A TUBE. Clara, Pierre; Foulquier, Henri; Peyrot, Jean-Pierre; Thome, Paul (to Commissariat a l'Energie Atomique). British Patent 1,182,534. 25 Feb 1970. Priority date 30 Mar 1967, France.

The design of a probe unit is given for measuring the circumferential length of the inner surface of a tube in a plane normal to the axis of the tube. The tool may be used for the determination of the diameter of pressure pipes and guiding tubes of nuclear reactors and for surveying the variations of these diameters resulting from deformations to which the tubes are subjected. The probe unit includes an electron camera for observing the inside of the tube. (J.C.W.)

25341 ON-LINE COMPUTER SYSTEM FOR THE NUCLEAR MEDICINE LABORATORY. Brown, Donald W.; Groome, David S.; Cleaveland, James D.; Trow, Richard S.; Lee, Jong Il (Univ. of Colorado, Denver. Denver Veterans Administration Hospital). J. Nucl. Med.; 11: 203-7(May 1970).

The role of the on-line computer in the nuclear medicine laboratory is briefly described. The computer is used in the analysis and display of radioisotope scanning data; in computer-assisted instruction; in inventory control; and in the storage, retrieval, and reporting of patient studies. Also, it is stated that computer analysis of complicated mathematical models of physiologic systems will probably become a routine part of clinical nuclear medicine in the future. (W.H.K.)

25342 IMPROVEMENT IN SAMPLING DEVICES. Trevalion, Peter Asquith; Swinhoe, Ronald (to United Kingdom Atomic Energy Agency). British Patent 1,178,687. 21 Jan 1970. Filed 24 May 1966.

The sampling apparatus described comprises a containment vessel having a double walled portion, the inner wall defining a chamber within the containment vessel and the outer wall defining, together with the inner wall, a fluid-tight space. A crucible is supported within the chamber by demountable support means, and inlet and outlet ducts are provided in the containment vessel whereby liquid can be directed to flow into and out of the chamber. Heater means are provided for the crucible. Means are also provided for fluid coolant to flow into and out of the fluid-tight space, and for heating the inner wall of the chamber. The apparatus is suitable for liquid sodium sampling. The demountable crucible support means may also serve as a fluid-tight closure for an access port to the chamber. (UK)

25343 INSTRUMENTATION IN MEDICINE. Proceedings of the Second European Symposium on Medical Electronics, London, March 14–17, 1967. London; World Medical Electronics (1967). 92p. (CONF-670339).

Separate abstracts for three of the thirty five papers presented were prepared. The papers are grouped as follows: experiences with patient monitoring systems, artificial internal organs, instrumentation for cardiovascular system, telemetry, bioengineering, electronic techniques in neurophysiology, radioisotope techniques and radiobiology instruments for clinical and laboratory examinations, the industrial approach to medical instrument development, computer systems and data processing, clinical applications of analog and digital computers, electrocardiography, phonocardiography, vectorcardiography, electronic techniques in obstetrics and gynaecology, respiratory physiology and anaesthetics. (UK)

For abstracts of individual papers see: 25285, 25286, and 25356.

Radiation Effects on Instruments and Instrument Components

Refer also to abstract 25267.

25344 (BNWL–1325) REACTOR ENGINEERING DEVELOPMENT. REACTOR ENVIRONMENTAL EFFECTS ON SIGNAL CABLES. Quarterly Report, October–December 1969. Stringer, J. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Mar 1970. Contract AT(45-1)-1830. 27p. Dep. CFSTI.

The development of a noise measurement system and furnace at a cobalt-60 facility for measuring radioinduced noise in cables is described. Radiation induced current, radiation and temperature dependent electrical noise, and radiation induced insulator conductivity are discussed. (W.H.K.)

25345 (N–70-16345) EFFECTS OF REACTOR RADIATION ON 4.7-VOLT SILICON VOLTAGE-REGULATOR DIODES. Weinstein, Suzanne T.; Maslowskii, Edward A.; Kroeger, Erich W. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Jan 1970. 15p. (NASA-TM-X–1930; E–5187). CFSTI.

Twenty-five silicon voltage-regulator (Zener) diodes were exposed to reactor radiation in a fast neutron fluence of 8.2 × 10 to the 13th power neutrons/sq cm and a gamma dose of 6.3 × 10 to the 7th power rads-carbon. The diodes were electrically energized in three different operating modes during irradiation. The Zener voltage remained constant, and the breakdown knee was somewhat softened. The forward- and reverse-leakage currents increased. The function capacitance remained unchanged. Electrical operating mode did not affect the radiation damage in these diodes. (auth) (USGRDR)

25346 NUCLEAR ENVIRONMENTAL TESTING TECHNIQUES AND PROBLEMS. Bell, J. E.; Phillips, D. H. (North American Rockwell Corp., Anaheim, Calif.). J. Environ. Sci.; 12: 15-18(Oct 1969).

A survey was made of nuclear radiation effects, measurements, and instrumentation hardening. Testing techniques and problems are emphasized, and a brief background in radiation effects, simulation-source selection, and dosimetry is presented. Primary consideration was given to problems unique to radiation testing. Machine-generated and radioinduced noise sources were identified, and techniques for noise reduction are given. Methods for minimizing effects due to radioinduced charge scattering, air ionization, and electromagnetic interference are discussed. Important radiation shielding and hardening considerations are summarized. (IAA)

25347 RADIATION DAMAGE EFFECTS IN A SURFACE BARRIER DETECTOR AFTER IRRADIATION BY 4.5 MeV α PARTICLES. Hanser, Frederick A.; Sellers, Bach (Panametrics, Inc., Waltham, Mass.). Rev. Sci. Instrum.; 41: 780-1(May 1970).

A 1 cm^2, 1000 $\Omega \cdot$cm surface detector was irradiated with α particles from a ^{241}Am vacuum sublimed source. The irradiation was carried out in air with α particles having about 4.5 MeV at the detector face. The detector was biased at 45 – 20 V during the irradiation. The radiation effects on the detector leakage current and resolution are described. (W.H.K.)

LIFE SCIENCES

Biochemistry, Physiology, and Molecular Biology

Basic Processes

Refer also to abstract 25333.

25348 (BNWL-1297) DDT IN A FRESHWATER MARSH: A SIMULATION STUDY. Eberhardt, L. L.; Meeks, R. L.; Peterle, T. J. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Mar 1970. Contract AT(45-1)-1830. 65p. Dep. CFSTI.

A computer simulation model was constructed to represent the dynamics of ^{36}Cl-labeled DDT in a Lake Erie marsh. An exponentially decreasing input function (representing release of DDT from the granular formulation in which it was applied) determines concentration in water, from which one- or two-compartment models represent the concentration in various forms of flora and fauna. Observational data on 10 plant species, six invertebrates, and three vertebrate species were modeled. Five species (a plant, an invertebrate species, and the three vertebrates) were used for a food-chain simulation. The overall results generally suggest that simple models, of the kind used to study radionuclide transfer through food chains, will provide reasonably good representations of the behavior of DDT in food chains. It is suggested that controlled experiments are needed to properly identify the components of a model, and that a number of questions about sampling methodology remain unanswered. (auth)

25349 DISAPPEARANCE RATES OF ENDOGENEOUS FOLLICLE-STIMULATING HORMONE IN SERUM FOLLOWING SURGICAL HYPOPHYSECTOMY IN MAN. Yen, S. S. C.; Llerena, L. A.; Pearson, O. H.; Littell, A. S. (Case Western Reserve Univ., Cleveland). J. Clin. Endocrinol. Metab.; 30: 325-9(Mar 1970).

The disappearance rates of endogenous FSH in serum following complete hypophysectomy were determined in five patients. Simultaneous determinations of serum FSH and LH were made in one patient. The hormone concentrations were measured by specific radioimmunoassays. Endogenous FSH disappears from circulation at a much slower rate than endogenous LH (approximately 10-fold). The disappearance rates for FSH, like that of LH, could be resolved into at least two exponential components. The initial fast component had a mean $t_{1/2}$ of 3.9 hr, which was followed by a second slow component with a mean $t_{1/2}$ of 70.4 hr. (auth)

25350 DETERMINATION OF TOTAL BODY WATER IN HEALTHY FILIPINO SUBJECTS WITH THE USE OF TRITIATED WATER. Lawas, Irineo (Univ. of the Philippines, Diliman). Philipp. J. Intern. Med.; 7: No. 2, 1-7(Jun 1969).

Total body water determinations were done in 33 normal healthy Filipino subjects using an in vivo dilution technique with tritiated water as tracer substance. Comparisons were made of results obtained using urine samples on the one hand and blood samples on the other hand. No significant difference was observed in results. Mean total body water of Filipino males was 36.3 liters and percentage body water value per kilo body weight was 61.4%. Corresponding figures for females were 23.8 liters and 50.8%. Filipino values were very similar to results of Edelman, Olrey, Brooks, and Moore [Sci. 115: 447(1952)]. (auth)

25351 USE OF ^{35}S FOR THE STUDY OF PLACENTA DEVELOPMENT. Gothie, S. (Hopital Broca, Paris). J. Biol. Med. Nucl.; 3: No. 13, 21-4(1968). (In French).

The interaction of the fertilized ovum and the maternal uterus from the moment of implantation of the embryo in the endometrium up to the fully developed placenta was studied in the doe-rabbit by means of ^{35}S. In the form of $Na_2{}^{35}SO_4$, methionine-^{35}S, and cystine-^{35}S and at the dose rate of $\frac{1}{2}$mCi/kg it was injected at definite times after mating and the distribution of activities examined by both autoradio-histographic and microradiochemical methods. The injections were made between the 7th and 8th and the 9th and 14th day after mating and it was found that the distribution of activities between the placental and embryonic tissues depends on the nature of the injected labeled compound and on the time of injection. From the obtained data inferences could be drawn on embryonal and placental development. In the early stages of placenta development large amounts of $Na_2{}^{35}SO_4$ are concentrated in the uterine mucosa and subsequently found in the covering membranes of the embryo containing large amount of sulfurated mucosaccharides. Towards the end of the development of the mesometric mucosa, particularly at the 13th day after mating, the activity from injected methionine-^{35}S jumps suddenly up in the placental tissues due to the production of large amounts of sulfur containing nucleoproteins, though the chorion shows still only a moderate ^{35}S activity. In this way ^{35}S gives an illuminating picture of the successive stages of placenta development following implantation. (F.J.W.)

25352 SCIENTIFIC USES. Schwan, Herman P. (Univ. of Pennsylvania, Philadelphia); Vogelhut, P. O. pp 235-44 of Microwave Power Engineering. Vol. 2. /Okress, Ernest C. (ed.). New York; Academic Press Inc. (1968).

The electrical properties of biological systems at microwave frequencies reflect their composition. Possible applications of microwaves in studies of the composition of biological systems are postulated. (C.H.)

25353 SEMIAUTOMATED TECHNIC FOR RADIOIMMUNOASSAY. DOUBLE ANTIBODY ASSAY OF INSULIN. Haas, Melvyn L.; Shenkman, Louis; Weissman, Peter; Andres, Reubin (Baltimore City Hospitals). Diabetes; 19: 127-31(Feb 1970).

A semiautomated modification of the double antibody assay for immunoreactive insulin, using commercial equipment and easily constructed accessories, was devised. It was found to be a convenient and reliable method for performing insulin assay upon large numbers of samples. (auth)

25354 PROGRAMS AIMED AT THE DEVELOPMENT OF A RADIOPHARMACEUTICAL FOR ADRENAL SCANNING. Nagai, Teruo (National Inst. of Radiological Science, Chiba, Japan). J. Nucl. Med.; 11: 217-18(May 1970).

Programs aimed at the development of a labeled compound for use in adrenal scanning are reviewed. Methods for the preparation of ^{18}F-labeled cholesterol with suitably high specific activity for use in scanning are reported. The compound has not been tested for adrenal scanning. (C.H.)

25355 PROGRAM OF EXPLORATION OF METABOLISM BY WHOLE-BODY SPECTROMETRY. Gongora, G. (Fondation Curie, Paris); Gongora, R.; Jammet, H.; Pages, J.-P.; Marchadier, B. J. Biol. Med. Nucl.; 3: No. 14, 15-17(1968). (In French).

The equipment used consisted of an armored cell, a scanning NaI detector for γ-radiation, a 400 channel pulse height analyzer, and an IBM 360 computer. The exploration began with 5 spectrometric measurements: dose before administration; residues in emptied container; whole-body scanning in dorsal and ventral position and in natural movement. Subsequent spectrometric measurements consisted only of the last three tests of the initial exploration. It was essential that in all these measurements the same geometrical conditions were observed. Finally, measurements of excreted activities in feces and urine were carried out. The exploration period lasted several days and the results were visually observed with an oscilloscope and also numerically recorded and registered on a magnetic or perforated tape to be fed into the computer. Programming was carried out with the FORTAN IV system according to a fixed organometric scheme. The data fell into 3 groups: labeling information—nature of radioisotope or labeled compound, name of person, date and hour of administration and examination, number of scanning spectrometries; numerical values of individual spectra, usually expressed in 100 informations per spectrum; diverse parameters such as duration of measurements, half life of radioisotope, and numbers of channels used. All these data were introduced in coded form into the computer that produced the end results in tabellaric form. Preferred radioisotopes for metabolic studies fell into three groups: ^{24}Na and ^{42}K were used for the study of total body diffusion; osteotropic ^{85}Sr, ^{87}Sr, and ^{45}Ca, and medullotropic ^{59}Fe for the study of diffusion along the sagittal axis; radioisotopes for special studies that accumulate preferably in liver, spleen, and kidneys. (F.J.W.)

25356 IN VIVO NEUTRON ACTIVATION ANALYSIS. Anderson, J.; Battye, C. K.; Osborn, S. B.; Tomlinson, R. W. S. (Kings Coll. Hospital, London). pp 60-2 of Instrumentation in Medicine. London; World Medical Electronics (1967).

From 2nd European Symposium on Medical Electronics, London, England. See CONF-670339.

Whole-body irradiation by 14 MeV neutrons and subsequent analysis in a low background whole-body monitor was undertaken on two volunteer subjects. The results are discussed. (UK)

25357 PERFUSION STUDIES WITH ^{99m}Tc HUMAN ALBUMIN MICROSPHERES (HAM). Burdine, John A.; Sonnemaker, Robert

E.; Ryder, Linda A.; Spjut, Harlan J. (Baylor Coll., Houston, Tex.). Radiology; 95: 101-7(Apr 1970).

The radiochemistry, toxicity, and clinical effectiveness of ^{99m}Tc-labeled human albumin microspheres (HAM), a new radiopharmaceutical for perfusion studies, were investigated. The tagging procedure is simple and rapid. No toxic effects were observed when up to 15 times the human organ equivalent of HAM was injected into the lungs of dogs, nor when doses up to 30 times the human equivalent were injected into the brain, kidneys, and celiac axis. Scintillation camera perfusion images of the human lung are excellent, with minimum initial radioactivity in the liver and spleen. (auth)

25358 RADIOIMMUNOASSAY OF HORMONES AND A CRITICAL REVIEW OF ITS APPLICATION TO ANGIOTENSIN ASSAY. Deodhar, Sharad D. (Cleveland Clinic Foundation). CRC Crit. Rev. Clin. Lab. Sci.; 1: 119-31(Jan 1970).

Recent developments in the chemical, chromatographic and electrophoretic methods of purification of proteins have permitted the preparation of many hormones in a high state of purity. This has removed one of the major objections to the earlier studies on the interaction of protein hormones and their corresponding antibodies. These developments rekindled interest in the application of immunological methods to the study of hormones and have led to the introduction of classical immunological techniques, such as precipitin titration, hemagglutination, and complement fixation in the assay procedures for growth hormone, insulin, thyrotropin, adrenocorticotropin (ACTH), gonadotropin, and other hormones. A further major advance in this area came through the introduction of radioanalytical techniques for immunoassay procedures. This radioimmunoassay technique was first used for the measurement of plasma levels of insulin in man and subsequently extended to methods for the determination of various hormones such as growth hormone, follicular stimulating hormone (FSH), luteinizing hormone (LH), parathormone, glucagon, gastrin and angiotensin. Others are still in their early developmental stages. The purpose of this review is to summarize the basic principles on which the technique is based, outline the different procedures based on this principle, discuss problems and pitfalls in the radioimmunoassay techniques and, critically review the current status of radioimmunoassay techniques for measurements of the hormone angiotensin. (auth)

25359 DISTRIBUTION OF DNA SYNTHESIZING CELLS IN HYPERPLASTIC EPIDERMIS AND PAPILLOMAS OF THE MOUSE SKIN. Frankfurt, O. S. (Inst. of Chemical Physics, Moscow). Tsitologiya; 12: 25-7(Feb 1970). (In Russian).

In the hyperplastic epidermis, only basal cells synthesized DNA, whereas spinous and granular cells remained unlabelled one hr after ^{3}H-thymidine injection. In papillomas, 10% of spinous cells synthesized DNA. Thus, papillomas of the mouse skin were characterized by a disturbance in the relationship between synthesis of DNA and differentiation. (auth)

Metabolism, Physiology, and Toxicology

Refer also to abstracts 25293, 25421, 25426, 25437, 25477, and 25557

25360 (A-AC-82/G/L-1289) THE EFFECTS OF NITROGEN SUPPLY CONDITIONS ON THE UPTAKE OF ^{90}Sr BY PLANTS FROM THE SOIL. Egorov, A. V.; Klechkovskii, V. M.; Sokolova, L. N. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). 1969. 11p. (In Russian). Dep. CFSTI (U. S. Sales Only).

Oat, pea, and lettuce plants were given nitrogen doses of 15, 75, 375 and 750 mg of nitrogen per 4 kg of sand. Sharp increases in plant yield were noted for the salad and oat plants, but not for the pea plants. No correlation between nitrogen dose and strontium accumulation could be observed for the lettuce plants, but a maximum in strontium-90 accumulation was noted at a nitrogen dose of 375 mg of nitrogen per 4 kg of sand. The strontium-90 content in the chaff and grain of the oat plants is decreased with increasing nitrogen dose. The pea showed strontium-90 accumulation only at the highest nitrogen dose of 750 mg of nitrogen per 4 kg of sand. (TTT)

25361 (A-AC-82/G/L-1295) EFFECT OF THE INTRODUCTION OF SODIUM SILICATE AND TRISODIUM PHOSPHATE INTO SOILS ON THE ACCUMULATION OF ^{90}Sr IN CROPS. Moiseev, I. T.; Rydkii, S. G. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). 1969. 16p. (In Russian). Dep. CFSTI (U. S. Sales Only).

Wheat and pea plants were grown in metal vessels containing 4 kg of air-dried soil (chernozem or podzolic). On treating the soil with sodium silicate or trisodium phosphate in amounts equivalent to the content of exchange calcium in the soil, it was observed that the strontium-90 content in the grain part of the plant decreased by a factor of 3 to 5. The decrease in the leaf and stem was greater than in the grain part of the plant. A decrease in the amount of added chemical by a factor of two (50% of the exchangeable calcium) led to a relatively sharp increase in strontium uptake. The effect of sodium phosphate is greater than that of sodium silicate in decreasing the strontium uptake by the plant. Field experiments with additions of sodium silicate equivalent to 200 to 300 of the exchangeable calcium led to a significant decrease in the grain (by a factor of 3 to 13) and in the chaff (by a factor of 2.5 to 7) in the first year, but the absorption of strontium-90 by the plants increased in the second year. (TTT)

25362 (A-AC-82/G/L-1296) ACCUMULATION OF ^{90}Sr TAKEN UP FROM THE SOIL BY VARIOUS CULTIVATED PLANTS UNDER FIELD EXPERIMENT CONDITIONS. Rydkii, S. G. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). 1969. 14p. (In Russian). Dep. CFSTI (U. S. Sales Only).

Data are presented on the accumulation of ^{90}Sr by plants in soil containing 1 curie of ^{90}Sr per km^2 and an exchangeable calcium content of 1 mg-equivalent/100 g of soil. These data can be used to predict the accumulation of strontium-90 by crops of these plants. The soil was a heavy-loam chernozem. The ^{90}Sr content in nanocuries per kg are given in parentheses after the various plants for the grain part of the plant: spring wheat (5.5), barley (4.5), oats (5.9), kazan millet (1.6), foxtail millet (Setaria italica) (5.4), rye (3.0), buckwheat (10.2), Voronezh corn (3.4), Moscow corn (1.7), Capital pea (8.4), Nemchinovskii pea (5.4), Russian bean (11.2), feed bean (4.9), kidney bean (5.8), oil-bearing flax (23.1), mustard (43.3), cameline oil plant (30.7), sunflower (4.7), potatoes (1.7), sugar beet (9.4), carrot (5.4), and turnip (13.9). The vegetative mass contained a significantly greater amount of ^{90}Sr (a factor of 10 to 50 greater). If the ^{90}Sr content in the soil is known, these data can be used to predict the ^{90}Sr content in the crop. (TTT)

25363 (BNWL-1221) PLUTONIUM INHALATION STUDIES. A Series of Lectures Given in Japan in 1969 at the Invitation of the Japanese Atomic Energy Commission. Bair, W. J. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Feb 1970. Contract AT(45-1)-1830. 284p. Dep. CFSTI.

Separate abstracts were prepared on seven papers in this report. (C.H.)

For abstracts of individual papers see: 25364–25368, 25477, and 25557.

25364 (BNWL-1221, pp 1.1-47) TECHNOLOGY USED IN PLUTONIUM INHALATION STUDIES. Park, J. F.; Stuart, B. O.; Willard, D. H.; Bair, W. J. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Equipment and procedures used for Pu inhalation studies in beagle dogs are described. These include ultrafiltration equipment for various ^{238}Pu and ^{239}Pu solutions, aerosol generators, glove boxes, aerosol exposure chambers, air exhaust systems, ventilation equipment, air monitors, and whole-body scanners for in vitro dosimetry of dogs following inhalation of ^{238}Pu or ^{239}Pu aerosols. The equipment was also used for inhalation studies of ^{144}Ce, ^{131}I, ^{237}Np, ^{147}Pm, ^{106}Ru, and ^{90}Sr in dogs, mice, and rats. (C.H.)

25365 (BNWL-1221, pp 2.1-44) THE DISPOSITION OF INHALED PLUTONIUM. PART I. COMPARISON OF CHEMICAL FORMS. Dilley, J. V.; Park, J. F.; Stuart, B. O.; Willard, D. H.; Bair, W. J. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Three plutonium compounds were studied in more than 200 beagle dogs to determine the dynamics of plutonium retention, distribution, and excretion following inhalation. While some studies were done with $Pu(NO_3)_4$ and PuF_4, the major interest has been PuO_2, which seems to be the plutonium compound most likely to be encountered in an accident situation. The results of this study show the relatively long-term pulmonary retention of inhaled PuO_2, its gradual accumulation in bronchial and mediastinal lymph nodes, and the accompanying low rate of translocation and excretion. None of the four types of PuO_2 deviated from this general pattern, although certain differences in their behavior were apparent, demonstrating the ability of biological processes to discriminate among compounds which were crystallographically indistinguishable. Certain radiation protection considerations are also implied by these results. Because of its greater accumulation in lymph nodes, the oxalate calcined at 350°C may be less hazardous than the other oxides. (C.H.)

25366 (BNWL-1221, pp 3.1-36) THE DISPOSITION OF INHALED PLUTONIUM. PART II. EFFECT OF PARTICLE SIZE.

Matsusaka, N.; Park, J. F.; Willard, D. H.; Bair, W. J. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Results obtained in a series of experiments on dogs clearly illustrate the important influence of chemical and physical properties of the inhaled Pu aerosol on the disposition of the Pu in the body. The findings are relevant to the potential biological effects which may occur after inhalation of Pu. Perhaps most significant are the implications these findings have on the interpretation of bioassay data. Thus, measurement of a single parameter such as urinary excretion hardly seems an adequate basis on which to estimate lung or body burden levels, especially in those cases where little is known about the material to which an individual was exposed. (auth)

25367 (BNWL-1221, pp 4.1-26) THE DISPOSITION OF INHALED PLUTONIUM. PART III. PULMONARY RETENTION OF ^{238}Pu MICROSPHERES. Dionne, P. J.; Park, J. F.; Stuart, B. O.; Willard, D. H.; Bair, W. J. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Particles of $^{238}PuO_2$ as large as 50 μm dispersed in air were inhaled by beagle dogs. The particles were deposited in the nasal pharynx region of the respiratory tract and excreted in the feces over a period of a few days. Apparently no particles were deposited in the lower respiratory tract, or if they were, clearance was rapid and complete. In 30 dogs, 50-, 120-, and 300-μm $^{238}PuO_2$ deposited in the lungs by intubation were cleared within 10 days. However, nine dogs retained particles for several months, up to a year in two cases. No biological effects were seen except for a possible lymphopenia in one dog which retained a 300-μm particle for over a year. (auth)

25368 (BNWL-1221, pp 5.1-33) CELLULAR INTERACTIONS WITH PLUTONIUM PARTICLES. Sanders, C. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Plutonium particles were phagocytized rapidly in rats, about 60 minutes following inhalation or intraperitoneal injection of $^{239}PuO_2$. The amount of particles phagocytized was nearly 90% or more in the peritoneal cavity and lung. The amount of activity administered, up to 19 μCi, did not prevent the subsequent phagocytosis of particles; blockage of particle uptake by macrophages was not observed. Particles were concentrated in macrophages; the net result was the creation of hot spots of intense α activity, more so than would be seen with only the limited range of 5 MeV alphas in tissue. This contributes to the already difficult problem of dosimetry. Particles were transported within macrophages to lymphatics. Particles not phagocytized by pulmonary macrophages were rapidly cleared. The retention time of particles in macrophages (not necessarily in the same macrophage) was of the order of several months. The distribution and retention of particles in macrophages appeared to be related in time with the amount of plutonium deposited in the alveoli. Structurally the macrophage was more radioresistant than other cells found in the peritoneal fluid. Particles were found in large lysosomes at one week after injection. Functionally (latex bead test) and structurally the macrophage exhibited a remarkable ability to ingest large amounts of plutonium and these cells also exhibit radioresistance. The behavior of plutonium particles in the body seems to be largely determined in the early phases by the kinetic behavior of macrophages. (C.H.)

25369 (COO-1630-22) METABOLISM OF RARE EARTHS FOLLOWING INHALATION: PATHOLOGIC AND BIOCHEMICAL RESPONSE IN THE LUNG AND OTHER ORGANS. Technical Progress Report, June 15, 1969–June 15, 1970. Berke, Harry L. (Wayne State Univ., Detroit, Mich. Dept. of Occupational and Environmental Health). 15 Mar 1970. Contract AT(11-1)-1630. 11p. Dep. CFSTI.

Abstracts or preprints of the following studies are presented. The pathological effects of repetitive exposure to $^{152-154}$Eu chloride in rats. The effects of the presence of food in the gastrointestinal tract on the absorption of large doses of stable europium following oral intubation. The roentgenographic determination of tracheal mucociliary transport in rats. The effects of uranyl nitrates on peripheral lymphocyte populations in rats. The occupational effects of x irradiation on the female x-ray technician. Pulmonary pathology in beagle dogs following intratracheal injection of $^{152-154}$Eu chloride. An improved aerosolizer is described that automatically compensates for changes in the concentration and volume of a solution during aerosolization resulting in the production of an aerosol of unchanging characteristics. (E.R.B.)

25370 BEHAVIOR AND CHARACTER OF MICRO-DISTRIBUTION OF ^{239}Pu IN THE RAT ORGANISM IN CHRONIC INHALATION OF ITS CITRATE COMPLEX. Lyubchanskii, E. R. Gig. Tr. Prof. Zabol.; 13: 39-42(Mar 1969). (In Russian).

Tests were set up on 94 rats to study the metabolism of ^{239}Pu during and following discontinuation of a 160-day long inhalation of ^{239}Pu citrate aerosols (SMD = 1 μc). It was ascertained that 160 days after inhalation the main organs containing deposits of the isotope were the lungs (576%) and the skeleton (1040%). Elimination of the isotope from the lungs and the skeleton proceeded with T_{ef} of 92.5 and 816 days. In the lungs, plutonium is distributed nonuniformly as stellae of varying density and chiefly in the peripheral portions. In the skeleton, the isotope was noted to distribute itself in a diffuse fashion without visible concentration on the surface areas. The number of tracks on the epiphysial plate and the diaphysis was much smaller than in the spongy substance of the epiphysometaphysial region. A good correlation was recorded between experimental and rated accumulation of ^{239}Pu in the lungs and the skeleton, following chronic inhalation of the isotope. (auth)

25371 EFFECT OF CHELATES ON UPTAKE OF SOME HEAVY METAL RADIONUCLIDES FROM SOIL BY BUSH BEANS. Hale, V. Q.; Wallace, A. (Univ. of California, Los Angeles). Soil Sci.; 109: 262-3(Apr 1970).

DTPA has the ability to increase uptake by plants of several metals. In the present study DTPA increased uptake from Hacienda and Yolo loam soils of ^{210}Pb and ^{241}Am. There was a decreased effect in the 2nd and 3rd harvests relative to the first. It had no effect on uptake of ^{125}Sb or ^{203}Hg. EDDHA increased uptake of ^{125}Sb from Yolo loam, and of ^{241}Am from both soils. The effect of EDDHA did not persist in the soil as much as did that of DPTA. DTPA increased slightly the uptake of ^{137}Cs. (auth)

25372 CASE OF A PARTIAL DEFECT OF THE IODIDE TRAPPING MECHANISM. Papadopoulos, S. N. (Athens Univ.); Vagenakis, A. G.; Moschos, A.; Koutras, D. A.; Matsaniotis, N.; Malamos, B.; Bismuth, J.; Bechet, M. M.; Lissitzky, S. J. Clin. Endocrinol. Metab.; 30: 302-7(Mar 1970).

A case of a partial defect of the iodide trapping mechanism is presented. The patient, a 9-yr-old boy, had a goiter, and a bone and mental age of 5 yr. The thyroidal radioiodine uptake and clearance were decreased and did not increase after TSH stimulation. Although the saliva/plasma ratio of iodide was definitely decreased, the iodide-trapping capacity of the salivary glands was not entirely absent. The thyroid/medium ratio of iodide in slices of thyroid tissue was 1.7. Light and electron microscopic studies were consistent with a functionally hyperactive gland. Biochemical investigation of the thyroid tissue showed a low iodine concentration and a poor iodination of thyroglobulin. (auth)

25373 SUPPRESSIBILITY OF THYROID FUNCTION DURING TREATMENT WITH ANTITHYROID DRUGS IN GRAVES' DISEASE. Wils, J. A.; Kloppenborg, P. W. C. (University Hospital, Nijmegen, Netherlands). J. Clin. Endocrinol. Metab.; 30: 406-7 (Mar 1970).

A high radioiodine uptake in the presence of a normal PBI, 24 hr after discontinuing antithyroid drug treatment in patients with Graves' disease, should not necessarily be interpreted to be a sign of gland autonomy. It is shown that identical findings can occur in normal subjects incorrectly treated with antithyroid drugs. The combination of these findings might be explained easily as the consequence of TSH overstimulation. (auth)

25374 LONG-TERM BEHAVIOR OF RADIOSODIUM IN BONE: COMPARISON WITH RADIOCALCIUM AND EFFECTS OF VARIOUS PROCEDURES. Forbes, Gilbert B.; McCoord, Augusta (Univ. of Rochester, N. Y.). Calcified Tissue Res.; 4: 113-28 (1969).

Rats were given ^{22}Na intraperitoneally and the retention of the isotope was determined in whole body and in bone for periods up to 650 days. In contrast to ^{45}Ca; that is rapidly taken up by bone and then very slowly released, most of the ^{22}Na taken up by bone leaves, with a half-time of 3 to 5.5 days. However, about 5% of the skeletal burden exhibits a very slow turnover, with a half-time of about 700 days. Since this rate is comparable to that of ^{45}Ca, it is concluded that this small fraction of bone Na is an integral part of the crystal structure. Only two of the several experimental procedures that were tried produced a significant effect on bone Na turnover. These were prolonged feeding of a low calcium diet and a change in parathyroid activity. An increase in dietary Na affected the fast component of bone Na turnover, but there was little if any effect on the slow component. Calculations from the data suggest that, in contrast to Ca, the skeleton does not serve a significant reservoir function for the support of extracellular fluid Na. (auth)

25375 THE DISTRIBUTION AND EXCRETION OF TRITIUM LABELED CEREBROSIDE (GALACTOSYL CERAMIDE) RADIOACTIVITY BY THE MONKEY. Burton, Robert Main (Washington Univ., St. Louis); Lewis III, Walter; Sodd, Mary Ann. Lipids; 4: 496-500 (1969).

Tritium-labeled galactosyl ceramide was administered intravenously to three male monkeys (Macaca mulatta). Blood, urine, feces and organs obtained at autopsy were examined for radioactivity after 1 hr, 8 hr, and 37 days. The radioactive galactosyl ceramide was taken up by the reticuloendothelial system. Very little radioactivity appeared in brain tissue. The radioactivity was excreted primarily in urine. (auth)

25376 MOVEMENT OF ^{14}C-PHOTOSYNTHATE INTO THE ROOTS OF WHEAT SEEDLINGS AND EXUDATION OF ^{14}C FROM INTACT ROOTS. McDougall, Barbara M. (CSIRO, Adelaide). New Phytol.; 69: No. 1, 37-46(1970).

When 8-day seedlings were exposed to $^{14}CO_2$ in light, approximately 2 hours were required for ^{14}C to reach the apices of the roots. One method used to detect the progress of ^{14}C down the root was to scan the root with a radiochromatogram strip scanner. At this stage most ^{14}C in aqueous ethanol extracts of roots was present as sucrose, equally labeled in glucose and fructose. This was converted only slowly to other components of the soluble fraction so that after 12 hours almost 50% of ^{14}C was still retained in sucrose. ^{14}C exuded from intact roots into surrounding solutions was present in both volatile and non-volatile compounds. In the non-volatile fraction glutamine, glutamic and aspartic acids were the main ^{14}C-amino acids. Exudation of ^{14}C was not affected by changing the inorganic composition of the collecting solution. A change in pH of collecting solution from 6.4 to 5.9 increased exudation. Exudation also increased markedly when 2,4-dinitrophenol or potassium cyanide was present in the collecting solution. (auth)

25377 ^{134}Cs RETENTION IN RATS FROM ONE TO 25 MONTHS OF AGE. Lengemann, F. W. (Cornell Univ., Ithaca, N. Y.). Contract AT(30-1)-2147. Radiat. Res.; 42: 169-74(Apr 1970).

The retention of a single dose of ^{134}Cs was followed for a period of 49 days in a group of male albino rats ranging in age from one to 25 months. The data showed that as the animals became older more cesium was retained. The retention increased 14 times between 1 and 4 months of age, 1.9 times between 4 and 21 months of age, and decreased 10% at 25 months of age. Equations were determined that could express the retention of radiocesium over time for each group as a sum of a series of 2 or 3 exponentials. The last component of the equation accounted for 12.1% of the body cesium in 1-month-old rats and 85% in 21-month-old rats. This change appeared to be more related to the body size than the age of the animal. Changes in the second component appeared to be inversely related to the changes occurring in the third component. The magnitude of the first component seemed to be independent of both age and size. (auth)

25378 CONTRIBUTION OF NUCLEAR LABELS TO THE IMPROVEMENT OF ANIMAL PRODUCTIONS. Gueguen, L. Bull. Inform. Sci. Tech. (Paris); No. 141, 63-75(Oct 1969). (In French).

The principal research done in animal husbandry since 1964 using nuclear indicators mainly concerns physiology and animal nutrition. The use of tritiated thymidine permitted germ cells to be marked and certain reproductive mechanisms to be better known. Our knowledge in endocrinology has been increased due to the use of marked steroids and methods of radio-immunological dosage. The growth of wool and hair has been studied using sulphur-35. Marked precursors were used in the study of protein synthesis in the mammal egg and the mammary gland. In the field of nutrition, the study of mineral metabolism progressed with the utilization of radioisotopes, namely, phosphorus, calcium, magnesium and iodine, but some work was also done on the metabolism of nitrogen, lipids, and vitamins. (auth)

25379 PECULIARITIES IN THE RADIOCHROMATOGRAPHIC DETERMINATION OF THE URINARY METABOLITES OF ^{35}S LABELED METHIONINE IN CERTAIN ILLNESSES. Szantay, I. pp 204-8 of Chromatographie Electrophorese. Bruxelles; Presses Academiques Europeennes (1969). (In French).

From 5th International Symposium on Chromatography and Electrophoresis, Brussels, Belgium. See CONF-680971.

The ^{35}S-labeled amino acid and ^{35}S-labeled amine fractions excreted in the urine of patients with epidemic hepatitis, active chronic hepatitis, and duodenal ulcer were identified using the semi-superposed control chromatographic method. The radiotaurine and radiomethionine eliminated by patients with these illnesses were determined and compared with normal values. The analysis shows that in epidemic hepatitis and chronic hepatitis the increase of the elimination of the ^{35}S-labeled fraction is caused by the increased elimination of methionine and taurine, both labeled with ^{35}S. In the duodenal ulcer, the high elimination of the radiotaurine is associated with a decrease of the urinary elimination of non-metabolized methionine. (J.S.R.)

25380 SUPPRESSION OF THYROIDAL IODINE UPTAKE AFTER INDOCYANINE GREEN. Dumlao, Juliet S.; Brooks, Marion H.; Krauss, M. Thomas; Bronsky, David; Waldstein, Sheldon S. (Cook County Hospital, Chicago. Northwestern Univ., Evanston, Ill. Univ. of Illinois, Chicago). J. Clin. Endocrinol. Metab.; 30: 531-2(Apr 1970).

The 24-hr thyroidal uptake of radioiodine (RAIU) is suppressed following administration of indocyanine green, dye commonly used to measure cardiac output. Studies were conducted in 21 normal subjects and 6 patients with hyperthyroidism to determine the mechanism responsible for this suppression and to evaluate its clinical significance. Analysis of the dye revealed that each 25 mg dose contained 1.274 ± 0.68 mg of inorganic iodide. Administration of indocyanine green had no effect on the protein-bound iodide concentration but significantly increased the serum inorganic iodide concentration of both groups. The most striking effect of indocyanine green was suppression of the RAIU. In normal subjects the mean decrease in RAIU was 6% but only 8 of the 21 subjects had a decrease of 5% or greater. In contrast, the mean decrease in RAIU of patients with hyperthyroidism was 33% and 4 of the 6 patients had normal values for RAIU after administration of the dye. (auth)

25381 MEASUREMENT OF URINARY FREE CORTICOIDS BY COMPETITIVE PROTEIN-BINDING RADIOASSAY IN HYPOADRENAL STATES. Hsu, T. H.; Bledsoe, T. (Johns Hopkins Hospital, Baltimore). J. Clin. Endocrinol. Metab.; 30: 443-8 (Apr 1970).

A modification of Murphy's competitive protein-binding radioassay for the measurement of urinary free corticoids in the low range is described. The modification includes the washing of the dichloromethane extract of urine, measurement of different-sized aliquots of the extract, and the use of a ^{3}H-corticosterone labeled human plasma pool and Florisil adsorbent. These changes in the method are easily done and improve the precision of the assay enough to establish a lower limit of urinary free corticoid excretion in normal subjects ranged between 16 and 71 μg/24 hr, with an average of 33 μg/24 hr. Patients with symptomatic adrenal insufficiency due to hypopituitarism, Addison's disease, or after withdrawal from long-term steroid therapy had values which ranged between 0 and 14 μg/24 hr. The validity of the results obtained by this direct extraction technique compares favorably with chromatographic methods using isotope dilution and double isotope derivative dilution techniques. The utility of the measurement of urinary free corticoid excretion is greatly increased by establishing a lower limit of excretion in normal subjects. This parameter of adrenal function should now be included as one of the important tests for the assessment of the physiologic status of the adrenal glands in patients suspected of having either hypercortisolism or adrenal insufficiency. (auth)

25382 METABOLISM AND TOXICITY OF INHALED AND INJECTED ^{131}I IN THE RAT. Thomas, Randi L.; Scott, J. K.; Chiffelle, T. L. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.). Amer. Ind. Hyg. Ass. J.; 31: 213-20(Mar-Apr 1970).

Rats were exposed by inhalation to aerosols contaminated with ^{131}I or intravenously injected with solutions containing ^{131}I, resulting in initial body burdens of 20 to 1200 μCi/kg body weight. Whole-body counting, excreta and tissue analyses, and pathological examinations were performed to evaluate retention differences or tissue changes due to route of administration or to initial ^{131}I body burden. Fifty to sixty percent of initially deposited ^{131}I was excreted during the first 24 hours after both modes of administration. With the exception of thyroid gland and pelt, all organs examined decreased in ^{131}I content the first day after inhalation exposure. Thyroid radioiodine increased during the first day to at least 3.2% of the initial body burden. Both transient and permanent changes, which were dependent on the initial quantity of ^{131}I received, were observed histologically in the thyroid gland. Some latent changes were also noted in the pituitary gland. (auth)

25383 KINETICS OF LYMPH NODE ACTIVITY ACCUMULATION FROM SUBCUTANEOUS PuO_2 IMPLANTS. Johnson, Lamar J.; Bull, Emory H.; Lebel, Jacques L.; Watters, Robert L. (Colorado State Univ., Ft. Collins). Health Phys.; 18: 416-18 (Apr 1970).

The dynamics of the movement and retention of ^{239}Pu in the lymphatic system of dogs is reported. Forty beagle dogs were treated with implants of oxidized PuO_2 and half of them given chelation therapy with D.T.P.A. The accumulation of radioactivity in the first major node draining the area of implant, the superficial cervical lymph node, was measured against time. There was no measurable difference between chelated treated and untreated dogs. The majority of the material remained at the implant site. It is shown that the lymphatic system is a major potential route of translocation of radioactive material from contaminated wounds and it is pointed out that this has not been appreciated by the International Commission on Radiological Protection. (UK)

25384 ^{90}Y IN GONADS OF MONKEYS CONTAINING ^{90}Sr. Mole, R. H. (Medical Research Council, Harwell, Eng.); Ward, A. H. Nature (London); 226: 175(11 Apr 1970).

Information on the distribution of ^{91}Y and ^{90}Y in tissues after intravenous injection of ^{91}Y or of ^{90}Y + ^{90}Sr is not very helpful in understanding the transfer of ^{90}Y from bone to soft tissues because of the overwhelming contribution of the directly injected Y. If, however, a mixture of ^{90}Sr and ^{90}Y is injected intramuscularly the ^{90}Sr is free to diffuse into the blood stream whereas the injected ^{90}Y is almost immobilized locally. The ^{90}Sr is largely taken up into the bones and in these circumstances the soft tissue content of ^{90}Y may be an index of transport of ^{90}Y formed in bone out of bone and into the blood stream. Some studies in this connection are described for a number of young adult monkeys. The radioactivity of the ovaries or testis was measured after death 24 and 25 days after injection. There was no unexpected concentration of ^{90}Y in the gonads. The results may be of significance concerning the possible genetic effects of ^{90}Sr. (UK)

25385 AN ELECTRON MICROSCOPIC STUDY ON THE UPTAKE OF LIPID, PROTEIN, INERT MATERIAL, AND VIRUSES BY THE SMALL INTESTINAL ABSORPTIVE CELLS OF SUCKLING MICE. Hung, Kuen-shan. Lawrence, Kan.; Univ. of Kansas (1969). 128p.
Thesis.

Eighty CFW$_w$ suckling mice were used to investigate the uptake of various materials by the small intestinal absorptive cells. Vegetable oil, ferritin, thorium dioxide, and 3 different types of viruses were inoculated separately into a ligated segment of the jejunum of fasted mice. At various times between 2 minutes and 6 hours 40 minutes, the ligated segments and their adjacent control jejunum were removed. A part of the duodenum, jejunum, and ileum was also taken from fasted control mice. All tissues were fixed in glutaraldehyde and osmium, dehydrated in ethanol, and embedded in araldite or an eponaraldite mixture. Electron microscopic examinations of the thin sections suggested that the ingestion of vegetable oil (lipid), ferritin (protein), and thorium dioxide (inert material) in the experimental jejunum, and intraluminal ribosomes (nucleo-protein) in the control ileum by the absorptive cells were primarily by pinocytosis. Osmiophilic fat droplets appeared in the lumen of the intestine, and in vacuoles at the apical cytoplasm of the absorptive cells of animals given vegetable oil. Dense particles were seen in the lumen of the intestine, between the microvilli, and the pinocytotic vesicles, of ferritin and thorium dioxide administered animals. Particles similar in size and density to ribosomes presumably derived from cell debris in the intestinal lumen were found in the intermicrovillous spaces, and in the pinocytotic vesicles. Evidence that suggested diffusion of ferritin molecules through the absorptive cell membranes was also presented. In contrast, rod shaped microorganisms were ingested by a phagocytic like activity of the control ileal absorptive cell. After ingestion, the administered materials were shown to take different intracytoplasmic routes. The vegetable oil was transported out of the absorptive cell through the intercellular spaces and basement membrane into the connective tissues beneath the absorptive cells, and it also appeared to be stored as intranuclear lipid inclusions in the absorptive cell. Ferritin was retained in the apical vacuoles, associated with lysosomes, and broken down intracellularly. Thorium dioxide was retained in the apical vacuoles, and was not found to be associated with the lysosomes. In some control ileum, microorganisms were attached to the epithelial cell, and intracellularly they were surrounded by a modified epithelial cytoplasm. The possible effects of this bacterium-cell relationship in the regulation of the renewal rate of the intestinal epithelium and in controlling the microbial flora in the gastrointestinal tract were discussed. The administered reovirus type 3, canine herpesvirus, and a leukemia virus did not penetrate the epithelial cell as intact particles. Some intact virus particles were found in the intestinal lumen and impeded at the tips of the microvilli. Later, the particles seemed to be degraded into smaller particulate materials located in the intestinal lumen and between microvilli. It was thus suggested that for large viruses such as those used in this study, the particles were degraded in the intestinal lumen and the released nucleic acid entered the cell as a separate entity if the infection is to occur. For smaller viruses, such as those in the picornavirus group that has a similar size and chemical composition to ribosomes, it was suggested that the intact particles may penetrate the absorptive cell directly by pinocytosis. (Diss. Abstr.)

25386 EFFECT OF DIETARY ANOMALIES ON MANGANESE METABOLISM. Howes, Arol Dean. Pullman, Wash.; Washington State Univ. (1969). 72p.
Thesis.

Twenty-five 2-year-old heifers were allotted into three treatment groups consisting of 8, 8, and 9 heifers for Groups 1, 2, and 3, respectively. These heifers were bred and maintained on 23.37, 13.90, and 16.27 ppm manganese for Groups 1, 2, and 3, respectively. There was no significant difference ($P > .05$) in the heifer's performance of the birth weight of the newborn calves. Two calves were sacrificed at birth from Groups 1 and 2 and three from Group 3. Three calves from each heifer group received a milk diet for seven days and the remaining calves were given milk supplemented with manganese. Supplementing newborn calves with manganese resulted in a 44-, 97-, and 115-fold increase in liver manganese concentration over the nonsupplemented calves. Manganese supplemented calves had a significantly higher ($P < .05$) manganese concentration in marrow-free bone than nonsupplemented calves. One calf from the manganese-supplemented calves and one from the nonsupplemented animals were given ^{54}Mn. In comparing the two calves, a higher fecal excretion and lower tissue retention of ^{54}Mn were found in the supplemented calf. This suggests that manganese is retained longer in lower dietary levels of manganese in newborn calves. Thirty-six female rats were allotted into six treatments consisting of three treatments partitioned for an adequate dietary level of manganese and three receiving a low level of manganese. Each of the allotted manganese treatments was equally subdivided into three groups and received 0, 40, and 80 ppm sparteine sulfate. Isotopes of ^{65}Zn and ^{54}Mn and activation analysis were used to delineate the mode of action of alkaloid consumption on mineral distribution. The kidney of gestating rats receiving both levels of manganese contained the highest level of ^{54}Mn which was diminished by the sparteine sulfate. The bone contained more ^{65}Zn and was decreased due to sparteine sulfate in the gestating rats receiving low manganese and increased in the supplemented rats. Newborn rats had decreased ^{54}Mn and ^{65}Zn activity in the manganese supplemented treatment and the low manganese treatment had an increase in ^{54}Mn and ^{65}Zn as sparteine sulfate was increased. Activation analysis of these newborn rats revealed a significant decrease ($P < .05$) in manganese concentration and a reduction in calcium and phosphorus. The reduction and/or increase in ^{65}Zn and ^{54}Mn activity and the manganese, calcium, and phosphorus concentrations caused by the addition of sparteine sulfate suggests that this alkaloid can cause a change in the retention of these elements. A method of radiochemical separation was developed for the determination of manganese by neutron activation analysis giving high reproducibility and sensitivity. (Diss. Abstr.)

Radiation Effects

Refer also to abstracts 25074 and 25611.

25387 (YALE–3960-2) CATECHOLAMINE METABOLISM FOLLOWING X-IRRADIATION OF MAMMALS. Technical Progress Report. Van Woert, Melvin H. (Yale Univ., New Haven, Conn. School of Medicine). Jan 1970. Contract AT(30-1)-3960. 8p. Dep. CFSTI.

The effect of 1800 R whole-body x irradiation on catecholamines and tyrosine hydroxylase (TH) and dopa decarboxylase (DD) activities in the adrenal glands and brain of rats was determined. The content of the catecholamines, norepinephrine, and epinephrine, was decreased in adrenals (maximum reduction at 84 hr) and unchanged in brain, while the TH and DD activities were increased in adrenals and unchanged (TH) or decreased (DD) in brain. It was concluded that at 84 hr post-irradiation (pre-terminal state in the animals), the greatest stress reactions were occurring in the rats associated with hypotension which may have triggered reflex stimulation of the adrenals. The increased synthesis of catecholamine could have resulted from increased adrenal TH and DD activities. The minimal effects observed in the brain suggested that there was little radiation effect directly on TH and DD activities or the catecholamine storage granules present there. Investigations using rats exposed to 700 to 1000 R doses of whole-body x irradiation at a dose rate of 65 R/min demonstrated that dopamine possessed radioprotective properties. When 60 mg/kg of dopamine were injected (I.P) into the rats immediately before exposure (1000 R), 50% survival in 30 days was obtained as opposed to no survivors among the irradiated controls. At 800 R, 100 mg/kg was most effective (55% survivors). A dose of 200 mg/kg of dopamine produced 100% lethality in non-irradiated animals within a few hours. Post-irradiation injection of dopamine had no effect on the survival of the rats in comparison with irradiated controls. The urinary catecholamine and dopamine contents of three leukemia patients were determined at 24 hr intervals the week before, during, and the week after whole-body γ irradiation at dose rates of 0.64 to 1.52 R/min or 0.5 to 5.0 R/hr. Values were all within the normal range with no significant change during the period of irradiation. Electron microscopic examination of C1300 mouse neuroblastoma tumors, known to possess high TH activity, demonstrated the presence of catecholamine storage granules and virus-like particles in the cells. Tumors induced in mice by cell-free extracts of these tumors were morphologically identical to the original tumor and retained the high TH activity. Tyrosinase activity was not detectable. Because of the high TH activity and the presence of catecholamine storage granules, the C1300 tumors will be used to examine further the mechanism of radio-induced increase in TH activity. The in vitro effect of chlorpromazine (CPZ) on TH activity in brain and adrenal glands was examined to determine if the mechanism of activation was similar to that for tyrosinase which is irreversibly activated by CPZ in vitro and in vivo. CPZ had no effect on adrenal TH activity in vitro at concentrations of either 10^{-6} or 10^{-3} M, and no effect on brain TH activity at the lower concentration. Increased TH activity in vivo was induced by CPZ through a mechanism unrelated to its effect on tyrosinase. (E.R.B.)

25388 MODIFICATION OF WHEAT GLIADIN BY γ-RAYS. Booth, M. R. (Flour, Milling, and Baking Research Association, Chorley Wood, Eng.). J. Sci. Food Agr.; 21: 145-7(Mar 1970).

Wheat gliadin was γ-irradiated under nitrogen with a dose of 20 Mrad. No significant changes were observed in the amino acid analysis, chymotryptic fingerprints, or elution curves from Sephadex G-200. Discrete bands were largely replaced by tailing in the starch-gel electrophoretic pattern. It is concluded that random bond scission has occurred, chiefly altering the side chains, and to some degree protein fragments have been grafted on to other sites. There is no definite evidence for the formation of macromolecular structures by inter-protein crosslinks. On average it is likely that of the order of only one or two bonds per molecule were affected. (auth) (UK)

25389 COMPARATIVE MEASUREMENT OF HYDROGEN CONCENTRATION OF THE BLOOD OF FEMALE TUMOR PATIENTS BEFORE AND AFTER PRIMARY RADIUM AND X-RAY IRRADIATION. Michalica, W. (Univ., Vienna). Krebsarzt; 24: 161-6(1969). (In German).

The blood pH was determined in ten healthy women, in 100 women with cancer of the genital tract before therapy, and in 100 women who were treated with radium and x radiation for cancer of the genital tract 5 years prior to the pH determination. The blood pH values found were: healthy controls 7.46; untreated cancer patients 7.51, and treated group 7.49. The decline in the pH values of the irradiated cancer patients as compared to the nonirradiated cancer patients was related to radiation exposure. (H.B.G.)

25390 ON THE EFFECT OF IRRADIATION ON VITAMIN E IN FOODS, ON TOCOPHEROL, AND ON TOCOPHEROL ACETATE. INFLUENCE OF DIFFERENT RADIATION CONDITIONS. Diehl, J. F. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.). Z. Lebensm.-Untersuch. Forsch.; 142: No. 1, 1-7(1970). (In German).

Vitamin E-destruction as a result of irradiation with electrons was compared in a number of foods. Losses were highest in products with high fat content. Losses of α-tocopherol in irradiated sunflower oil were not influenced by the presence of water, but greatly influenced by the tocopherol concentration. Tocopherol was more radiation resistant than tocopherol acetate. The protection provided by the exclusion of atmospheric oxygen during irradiation was small with tocopherol acetate, considerable with tocopherol. With tocopherol acetate dissolved in sunflower oil or in oil-water emulsion, the exclusion of atmospheric oxygen resulted in a 20% reduction of the loss caused by irradiation. Changes of dose rate in the ratio 1 : 100 had no effect on the loss caused by irradiation of α-tocopherol acetate. (auth)

25391 ROLE OF THE SPLEEN IN IRON METABOLISM. Mazur, Abraham (New York Blood Center, N. Y.). Contract AT(30-1)-3976. Ann. N. Y. Acad. Sci.; 165: 311-19(20 Nov 1969).

To study iron metabolism, the enzyme ferrochelatase was used as indicator. Rats received various chemical agents as well as lethal doses of x radiation. In the irradiated animals, enzyme activity declined sharply within two days; however, when the spleen was shielded, the decline was followed by a sharp rise beginning on the 8th day postexposure. In addition, radiation effects on ^{59}Fe-labeled hemoglobin, ^{59}Fe-labeled ferretin, and ^{14}C-labeled DNA were studied in spleen slices of shielded and non-shielded animals. The spleen-shielded animals showed enhanced ferretin formation and increased mitotic activity following whole-body x radiation. (H.B.G.)

25392 INTERMEDIATES IN THE ASSEMBLY OF φX174. Tonegawa, Susumu; Hayashi, Masaki (Univ. of California, San Diego, La Jolla). J. Mol. Biol.; 48: 219-42(14 Mar 1970).

Escherichia coli HF4704 (HCR$^-$) irradiated with uv light was used as the host to study early stages of the assembly process of the φX174 phage particle. Two φX174 specific precursor particles, 9 and 6 s were found. The 9 s particle is composed solely of the gene product from cistron E and is probably E protein trimer, whereas the 6 s particle is an aggregate of the cistron F proteins, most likely a pentamer. Formation of 9 and 6 s particles does not require the function of φX gene products other than E and F, respectively. A particle sedimenting at 20 s and composed of E protein and non-phage proteins was also found. This particle can be formed during cell lysis and subsequent sucrose gradient centrifugation from E protein monomer and non-phage proteins existing in the cell. In contrast, the 9 and 6 s particles are not so formed. The significance of these particles in the early stages of φX174 phage assembly is discussed. (auth)

25393 STUDIES ON RNA SYNTHESIS PRIMED BY DAMAGED TEMPLATES. I. DNA TEMPLATES DAMAGED BY DEOXYRIBONUCLEASE TREATMENT AND BY γ RADIATION. Goddard, J. P.; Weiss, J. J.; Wheeler, C. M. (Univ. of Newcastle-upon-Tyne, Eng.). Biochim. Biophys. Acta; 199: 126-38(Jan 1970).

The template activity of native DNA in RNA synthesis in vitro was studied after damage by deoxyribonuclease I, deoxyribonuclease II and γ radiation under different conditions. From the results obtained with deoxyribonuclease-damaged templates the model proposed earlier in which damaged sites on native DNA are considered to be capable of binding RNA polymerase, but fail to initiate synthesis of RNA, was used to calculate n, the number of nucleotide pairs per binding site on native DNA, for which a value of about 500 was found. This is in reasonable agreement with values obtained by other workers using different experimental techniques. γ-irradiation of aqueous solutions of DNA under aerobic conditions was found to lead to an increased binding capacity for RNA polymerase but a lowering of its priming ability for RNA synthesis in vitro. These observations can be explained by the radiation-produced formation of new binding sites, i.e., 2.1 sites per 100 eV of radiation energy absorbed, of which however only 0.6 site per 100 eV was active in the RNA synthesis. DNA in aqueous systems irradiated under conditions where only radiation-produced hydrated electrons can react with the DNA molecule (anaerobically and in the presence of ethanol as OH scavenger) gave smaller yields and only inactive binding sites (0.1 per 100 eV) were produced. (auth)

25394 CHEMICAL NATURE OF CHAIN BREAKS PRODUCED IN DNA BY X-IRRADIATION IN VITRO. Kapp, Daniel S.; Smith, Kendric C. (Stanford Univ. School of Medicine, Calif.). Radiat. Res.; 42: 34-49(Apr 1970).

X-irradiation of aqueous solutions of calf thymus DNA led to the production of chain breaks, the liberation of inorganic phosphate, the formation of phosphomonoester groups, and the production of a malonic aldehyde-like product due to damage to deoxyribose residues. For each single-chain break produced in DNA by x irradiation in 0.15M NaCl, 0.60 molecules of malonic aldehyde-like product were formed; 0.33 molecules of inorganic phosphate were liberated; and 1.35 molecules of phosphomonoester groups were produced. Of the phosphomonoester groups liberated, 29% were 5′-phosphoryl groups. The ratio of newly formed 5′-phosphoryl termini to 5′-hydroxyl termini was 32 : 1. The presence of 0.001M l-histidine reduced the number of single-chain breaks by a factor of 0.39, the yield of inorganic phosphate by 0.24, the formation of phosphomonoester groups by 0.42, and deoxyribose damage by 0.41. (auth)

25395 FOLATE METABOLISM IN THE X-IRRADIATED RAT. Viswanathan, Gomathy; Noronha, J. M. (Bhabha Atomic Research Centre, Bombay). Radiat. Res.; 42: 141-50 (Apr 1970).

Tissues from x-irradiated rats were analyzed for changes in folate activity. Blood and liver total folate levels were unaffected. Total folate levels were lowered in the spleen, and the decrease in the conjugated folate levels of the bone marrow from irradiated rats was quite significant. An observed rise in free bone marrow conjugase levels in the irradiated animals could be correlated with accumulation of unconjugated tetrahydrofolates in the tissue at the expense of the metabolically more active conjugated derivatives involved in nucleic acid biosynthesis. There was a decrease in the folate-dependent incorporation of the β-carbon atom of serine into bone marrow nucleic acid fractions from irradiated rats. The hydrolytic bone marrow folyl conjugase activity had an acidic pH optimum and in comparative studies was shown to exhibit a structure-linked latency similar to acid phosphatase, a known lysosomal marker enzyme. (auth)

25396 EFFECT OF HYPOXIA, IRRADIATION, AND BONE MARROW TRANSPLANTATION ON ERYTHROPOIETIN LEVELS IN MICE. McDonald, T. P.; Lange, R. D.; Congdon, C. C.; Toya, R. E. (Univ. of Tennessee Memorial Research Center and Hospital, Knoxville. Oak Ridge National Lab., Tenn.). Contract AT(40-1)-3547. Radiat. Res.; 42: 151-63(Apr 1970).

Preliminary studies indicated that plasma levels of erythropoiesis-stimulating factor (ESF) increase in mice after irradiation and hypoxia. ESF production was studied in five groups of female B6C3F$_1$ mice. Exposure of mice to hypoxia (approx. 7% O$_2$) by enclosure in silicone rubber membrane cages resulted in ESF levels of about 2.5 units of ESF per milliliter of plasma at 24 hr. The circulating ESF levels then described to less than 1 unit/ml as the hematocrit values increased. Mice subjected to 450, 750, 950, and 1200 R of x rays and kept at normal O$_2$ levels had undetectable amounts of ESF until day 8. After 950 R ESF levels then rose sharply as hematocrits decreased, and on day 10 the mice produced about 4 units of ESF/ml of plasma. In experiments in which mice were exposed to x rays and hypoxia, distinct cyclic elevations of ESF activity were observed. Mice given bone marrow transplants (injection of 1, 5, and 15×10^6 homologous bone marrow cells) after irradiation did not show the characteristic increase in ESF levels by day 10. However, markedly increased levels of ESF with obvious cyclic elevations were observed in mice enclosed in membrane cages after irradiation and bone marrow transplantation. These data indicate that transplantation of small numbers of bone marrow cells markedly alters the pattern of ESF elaboration after otherwise lethal doses of x ray. (auth)

25397 INTERACTIONS OF THE COMPLEMENT SYSTEM WITH ENDOTOXIC LIPOPOLYSACCHARIDES IN IMMUNOGLOBULIN-DEFICIENT SERA. Gewurz, H.; Pickering, R. J.; Snyderman, R.; Lichtenstein, L. M.; Good, R. A.; Mergenhagen, S. E. (Univ. of Minnesota Hospitals, Minneapolis. National Inst. of Dental Research, Bethesda, Md. Johns Hopkins Hospitals, Baltimore). J. Exp. Med.; 131: 817-31(1 Apr 1970).

Bacterial lipopolysaccharides (LPS) derived from a variety of organisms effectively induced complement (C) consumption in man, cattle, and swine with developmental agammaglobulinemia; birds with experimental agammaglobulinemia; and man with agammaglobulinemia syndromes. This interaction proceeded even in precolostral piglet sera that contained less than 2.5×10^{-6} mg/ml gamma globulin, and led to generation of neutrophil chemotactic factor and anaphylatoxin in these sera. Hence, the LPS-C interaction can proceed in sera markedly deficient in immunoglobulin. The question of whether immunoglobulins can be bypassed in the LPS-C interaction, or whether they are regularly utilized in a way so efficient that their participation is masked, was considered. (auth)

25398 DIURNAL RHYTHM OF MITOTIC ACTIVITY IN THE WHITE RAT RECTUM EPITHELIUM IN THE COURSE OF ACUTE RADIATION DISEASE. Svetikova, K. M. (Inst. of Experimental Medicine, Leningrad). Tsitologiya; 12: 247-50(Feb 1970). (In Russian).

The diurnal rhythm of mitotic activity in the rectum epithelium crypts of white rats was studied. In norm, the maximum is attained in the afternoon hours, 32.2 ± 4.3‰, whereas the minimum is registered at midnight, 19.0 ± 2.2‰ ($P = 0.025$). It was shown that at the climax of acute radiation disease the corresponding diurnal rhythm is changed, with the maximum being in the evening hours, 6–9 p. m., –41.0 ± 3.8‰ and the minimum in the morning hours, 6 a. m., 24.6 ± 4.8‰ ($P = 0.0002$). The average value of the diurnal mitotic activity in the irradiated animals was higher than that in the controls, 36.7 ± 2.7 and 25.6 ± 2.2‰ respectively, $P = 0.002$. (auth)

25399 INTRANUCLEAR VACUOLES IN IRRADIATED LYMPHOCYTES. ELECTRON MICROSCOPE STUDIES. Stefani, Stefano; Tonaki, Hiroshi (Veterans Administration Hospital, Hines, Ill. Univ. of Chicago). Arch. Pathol.; 89: 440-5(May 1970).

Human lymphocytes fixed two to 18 hours after x irradiation in vitro manifested dilatation of the perinuclear space in many cellular sections, sometimes with invagination of the inner nuclear membrane into the nucleus. Sections through these invaginated areas would give the false impression of intranuclear vacuole. This electron microscope study failed to reveal any sign of associated damage to the nucleus; specifically, there were no intranuclear vacuoles as described in previous work using light and phase microscopes. The findings contradict also previous reports indicating the intranuclear vacuole to be the initial or one of the first signs of radiation-induced degeneration. The present investigation tends to implicate the plasma membrane as the site of the initial and most important events leading to lytic or interphase cellular death. (auth)

25400 EFFECTS OF IONIZING RADIATION ON MYELINOGENESIS IN THE CHICKEN. Granich, M.; Atherton, R. W.; Timiras, Paola S. (Univ. of California, Berkeley). Experientia; 26: 179-80(15 Feb 1970).

Immature (24 days old) white Leghorn cockerels were whole-body ^{60}Co γ-irradiated at 1.4 R/min to a dose of 1600 R. Radiation effects on growth of adrenals, body, brain, and testes was measured by weight. Growth of each was retarded. The effects of radiation on total lipid, total sphingolipid, cerebroside, and cholesterol were also measured. Total lipid content of brain was low compared to controls, but this was attributed primarily to differences in brain weight. When results for lipid components were expressed as per cent of total lipid, cholesterol content was unaltered, and sphingolipid was significantly less in irradiated than in control brains. There was a negligible decrease in the per cent of cerebroside. The value of detailed lipid analyses is discussed. (C.O.)

25401 DEMONSTRATION OF A MACROMOLECULAR COMPLEX SOLUBILIZED FROM GUINEA PIG EPIDERMIS BY ULTRAVIOLET LIGHT. Black, Owen Jr. Norman, Okla.; Univ. of Oklahoma (1969). 60p.

Thesis.

Ultraviolet irradiation of guinea pigs results in the appearance of opalescence in the supernatant fraction of 0.3 M sucrose epidermal homogenates. The opalescent material, isolated by gel filtration was shown to have a large size or molecular weight. The amount of material was not affected by vascular circulation. It occurred in greater quantity when isolated immediately following irradiation than when isolated after a 4-hr delay. The material appeared to be a specific response to uv injury, since the thermal injury failed to provoke the response. The response was not dose dependent and appeared to require one MED exposure to uv. The protein associated with the material had an electrophoretic mobility similar to the α-globulins and was immunologically identical to a serum α-globulin. Electron microscopic evidence indicated the material had a spherical, lipid-like appearance, averaged 0.1 μ in diameter, and lacked definite structure. Chemical evidence indicated the opalescent material contained a glycoprotein moiety since it contained amino sugars, nexoses, and sialic acid. The material was shown to contain increased amounts of cholesterol (as free cholesterol) and protein, and decreased amounts of lipid phosphorous when compared to non-irradiated preparations. Gas liquid and thin layer chromatography showed that fatty acids, neutral lipids, and phospholipids were not qualitatively altered. Alkaline phosphatase enzyme assays indicated that although microsomes were present their content was not altered with uv light treatment. The material solubilized by uv irradiation was immunologically, electrophoretically, and chromatographically similar to material solubilized by phospholipase A. The evidence is consistent with the hypothesis that uv irradiation of guinea pig epidermis results in the specific solubilization of an intracellular organelle. This solubilization, perhaps, leads to aggregations of large particles that results in increased turbidity of the solution. Concomitant with, or as a result of the solubilization, there is an increase in a free cholesterol-protein complex and a decrease in lipid phosphorous. Electron microscopic evidence from other workers shows large vacuoles appearing in uv-irradiated epidermis, that perhaps, may contain this opalescent material. (Diss. Abstr.)

25402 TWO FORMS OF REPAIR OF DNA IN MAMMALIAN CELLS FOLLOWING IRRADIATION. Elkind, M. M.; Kamper, C. (Brookhaven National Lab., Upton, N. Y. National Cancer Inst., Bethesda, Md.). Biophys. J.; 10: 237-45(1970).

When Chinese hamster cells are lysed on top of an alkaline sucrose gradient, in time a fairly discrete DNA-containing molecular species is released from an apparently more complex material. Small doses of x radiation speed the resolution of this complex while large doses degrade the material released from it. Incubation after irradiation reverses both effects. (auth)

25403 INFLUENCE OF IRRADIATION OF THE SEEDS ON THE GROWTH AND PHYSIOLOGICAL MODIFICATIONS OF TOBACCO. Taranov, O. N. Tr. Inst. Bot. Akad. Nauk Kazakh. SSR; 26: 97-104(1968). (In Russian).

A two-phase stimulatory effect was seen in tobacco plants following exposure of the seeds to 25 Ci of ^{60}Co with a dose rate of 840 R/min. The gradient of catalase fermentation activity in the leaves of plants from irradiated seeds did not differ from that in leaves of plants from non-irradiated seeds in relation to the type and direction of the leaf series, however, the fermentation activity in the lower leaves of plants from irradiated seeds was inhibited while in the upper leaves it was stimulated as compared to plants from non-irradiated seeds. The content of chlorophyll in the leaves during the complete budding phase did not exhibit any strong variations between plants from irradiated and non-irradiated seeds. The increased physiological activity in the leaves of tobacco plants from irradiated seeds was the result of the reaction of the total plant to the pre-sowing treatment. (R.V.J.)

25404 ASSAY OF UREASE ACTIVITY USING ^{14}C-UREA IN STORED, GEOLOGICALLY PRESERVED, AND IN IRRADIATED SOILS. Skujins, J. J.; McLaren, A. D. (Univ. of California, Berkeley). Soil Biol. Biochem.; 1: 89-99(1969).

Soils from adverse and diverse climatic and geographic areas, and stored for various lengths of time, were examined for their urease activities. During a period of 26 months of air-dry storage of Hawaiian and Puerto Rico latosols, one soil showed an increase in activity to 108.5 per cent and others a decrease to as little as 36 per cent. Urease activity found in 6 to 12 years stored, air-dry agricultural soils correlated with the organic matter content rather than with the numbers of microorganisms. In samples from the 60-years-old Hilgard soil collection, urease activity reflected both the organic carbon content and the numbers of organisms present. Measurable urease activities were detected in 8715 and 9550-years-old, radiocarbon dated, Alaska permafrost samples. No activity was detected in a 32,000-years-old sample. No urease activity was present in two high-salinity soils. Urease activity was detected in an alkali soil and in an acid soil, but highest activity was usually found in neutral soils. A high-energy electron-beam irradiation dosage of 4 Mrad increased urease activity in some soils, but decreased activity in two others. Doses of 8 Mrad decreased urease activity below their native levels in all soils. Evidently, an intracellular urease component becomes more accessible to substrate upon death of organisms. This effect is observable because of the strong resistance of soil urease to radiation inactivation. Urea-amended Dublin soil, subjected to incubation at 80 per cent relative humidity showed a measurable urease activity. It appears that an extracellular component of soil urease becomes associated with inorganic and organic soil colloidal particles and retains its activity for extended periods of time. A new method for urease activity determination in soils was devised, based on the detection of $^{14}CO_2$ release from ^{14}C-urea-amended soils. (auth)

Immunology

Refer also to abstract 25532.

25405 (COO-2055-1) GRAFT VERSUS HOST INHIBITION. V. INCUBATED SPLEEN AND LIVER CELLS TO MINIMIZE SECONDARY DISEASE IN ALLOGENEIC RADIATION CHIMERAS. Technical Progress Report. Bortin, Mortimer M. (Mount Sinai Hospital, Milwaukee, Wis. May and Sigmund Winter Research Lab. Marquette Medical School, Inc., Milwaukee, Wis.). [25 Feb 1970]. Contract AT(11-1)-2055. 15p. Dep. CFSTI.

Efforts to improve the viability of liver and spleen stem cell mixtures from mice, under various conditions of incubation, were completed. Although the results did not lend themselves to formal statistical analysis, the data suggested that cells incubated using TC 199 in an atmosphere containing 7% CO_2 with 12½% or 25% fetal calf serum had best survival. Experiments designed to determine the radioprotective ability of liver and spleen stem cell mixtures are currently in progress. Using stem cell mixtures from whole-body x-irradiated mice, the effects of incubation under a variety of conditions on the radioprotective ability will be determined. Experiments designed to determine whether liver and spleen stem cell mixtures from whole-body x-irradiated mice, after incubation under a variety of conditions, could be used for hematopoietic reconstitution across strong immunogenetic barriers without producing death from secondary disease are also currently underway. (E.R.B.)

25406 CELLULAR SITES OF IMMUNOLOGIC UNRESPONSIVENESS. Chiller, Jacques M.; Habicht, Gail S.; Weigle, William O. (Scripps Clinic and Research Foundation, La Jolla, Calif.). Proc. Nat. Acad. Sci. U. S.; 65: 551-6(Mar 1970).

The reconstitution of the immune response of lethally x-irradiated mice to human γ-globulin is dependent on the synergistic action of bone marrow with thymus cells. Immunologic unresponsiveness appears to involve a functional defect at each of these cellular levels, inasmuch as neither bone marrow nor thymus cells from unresponsive donors are capable of demonstrating synergism in combination with their normal counterpart. (auth)

25407 IMMUNITY OF EHRLICH'S ASCITES CELLS OBTAINED BY CELL RADIATION. Melan, F.; Testorelli, C.; Tosi, G. (Univ., Milan). Arch. Ital. Patol. Clin. Tumori; 11: 285-99(Jul-Dec 1968). (In Italian).

That betatron irradiation of Ehrlich ascites cancer cells can impede their development without abolishing the selective membrane permeability was demonstrated. Administration of irradiated Ehrlich cells make the animals resistant to a successive inoculum, three weeks later, of viable cells, even in very large amounts. The protection obtained through the irradiated cells was far higher than that obtainable by way of freeze-thawed cells. A certain degree of immunity was still present three months after the administration of irradiated cells. If, during the immune condition, viable cells were administered, these, although in a small amount and incapable of hatching, prolonged the intensity and length of the immunity. It was not possible, by injecting subcutaneously irradiated cells, also in very high number, to make the animals resistant to an immediately successive inoculum by parenteral route of viable cells. It was, however, possible to reach a consistent degree of inhibition of tumor development by treating the animals after inoculation of viable cells with splenocytes obtained from animals previously vaccinated with irradiated cells. (auth)

25408 EFFECT OF TOTAL BODY IRRADIATION ON THE IMMUNE RESPONSE OF RHESUS MONKEYS TO A SINGLE ANTIGENIC STIMULUS. Bogden, Arthur E.; Eltringham, James R.; Anderson, Donald R. (Mason Research Inst., Worcester, Me. Brooks Air Force Base, San Antonio, Tex.). Contract F41609-67-C-0044. Radiat. Res.; 42: 90-104(Apr 1970).

Rhesus monkeys were individually whole-body ^{60}Co γ-irradiated at a midline dose rate of 54.6 rads per min. Immediate and delayed effects on the response capability of lymphoid tissues to a single antigenic stimulus were tested by injecting a nonproliferating antigen (sheep cells) 2 and 24 hr postirradiation. While 800 rads was lethal, 400 rads significantly impaired the immunologic response as indicated by prolongation of both the latent and production periods whether antigen was injected 2 or 24 hr postirradiation. A drop in rate of antibody synthesis included both the γM and γG types. Wide variations in natural anti-sheep cell heterohemagglutinins (γM type) in the rhesus monkey necessitated pretesting and selection of experimental animals to ensure an adequate antigenic stimulus. The induction phase of the immune response proved to be most radioresistant with evidence of selective enhancement of peak titers when irradiation preceded antigen administration by 2 hr. (auth)

25409 THE ENHANCING EFFECT OF BONE MARROW CELLS ON THE PRIMARY IMMUNE RESPONSE OF THE ISOLATED PERFUSED SPLEEN. Atkins, Robert C.; Robinson, William A.; Eiseman, Ben. (Univ. of Colorado, Denver). J. Exp. Med.; 131: 833-42(1 Apr 1970).

The addition of bone marrow cells or peripheral lymphocytes to the isolated pig spleen markedly enhanced the primary antibody response after 3-day perfusion and antigenic challenge in vitro. The splenic preparation without added cells or with the addition of marrow cells to γ-irradiated spleen gave a limited response. Contributory evidence is provided that at least two distinct cell types are needed for antibody production. For optimal antibody response by an isolated perfused spleen, marmow cells, or peripheral lymphocytes should be added to the system. (auth)

25410 EVIDENCE FOR TRANSFORMATION OF SPLEEN CELLS ONE DAY AFTER INFECTION OF MICE WITH FRIEND LEUKEMIA VIRUS. AUTONOMOUS GROWTH POTENTIAL AND EXPRESSION OF HYBRID-RESISTANCE GENES. Rossi, Giovanni B.; Cudkowicz, Gustavo; Friend, Charlotte (City Univ. of New York. State Univ. of New York, Buffalo). J. Exp. Med.; 131: 765-81(1 Apr 1970).

Proliferation and erythroid differentiation of transplanted DBA/2 marrow cells and Friend virus-induced leukemic cells were assessed in syngeneic, allogeneic (H-2 compatible), and (BALB/c × DBA/2)F_1 hybrid mice (CDF_1). Measurements were made 5 days after transplantation of donor cells into nonirradiated or x-irradiated mice by the spleen colony or the ^{125}IUdR-^{59}Fe uptake methods. Growth of DBA/2J (Jackson subline) marrow grafts was poor in irradiated CDF_1J hybrids as compared with growth in syngeneic and allogeneic hosts. The DBA/2J transplants proliferated, however, without impairment in irradiated CDF_1 hybrids which were the progeny of DBA/2 male parents of other sublines, e.g., DBA/2Ha, DBA/2Cr, and DBA/2Cum. In contrast, tissue-cultured Friend leukemic cells of DBA/2J origin grew deficiently in all CDF_1 hybrids tested, regardless of irradiation and of the DBA/2 parent's subline. The growth pattern of transplanted DBA/2J cells was a manifestation of hybrid resistance. The results with DBA/2J and other DBA/2 subline grafts suggested that hybrid histocompatibility alleles were expressed to a greater extent in leukemic than in normal marrow cells, for the former were consistently recognized as nonself by CDF_1 mice, but not the latter cells. The property of deficient growth in irradiated CDF_1Ha hybrids was acquired by DBA/2J hemopoietic cells within 6 hr from infection in vivo with Friend leukemia virus, and persisted during the following 8 days. It was ascribed to enhanced expression of hybrid histocompatibility gene(s) (Hh) induced by the virus. Autonomous growth potential of hemopoietic cells, manifested by proliferation in nonirradiated recipients, was first detected 24 hr from infection, and likewise persisted at the later intervals. At the same time, the infected cells grew deficiently also in nonirradiated CDF$_1$Ha mice. The two irreversible cellular changes were regarded as the earliest signals of virus-induced transformation. (auth)

25411 CELL TO CELL INTERACTION IN THE IMMUNE RESPONSE. V. TARGET CELLS FOR TOLERANCE INDUCTION. Miller, J. F. A. P.; Mitchell, G. F. (Walter and Eliza Hall Inst. of Medical Research, Melbourne). J. Exp. Med.; 131: 675-99(1 Apr 1970).

The nature of the interaction that takes place between thymus and non-thymus-derived lymphocytes is not understood. Clearly, the antibody-forming cell precursor is not thymus-derived, but it is not known whether the thymus-derived cell, the nonthymus-derived cell, or both, can recognize and react specifically with antigen, and thus determine the specificity of the response. In an attempt to study this question, experiments were performed with mice rendered specifically tolerant of SRBC. Results are presented that indicate that target cells for tolerance induction exist in the thymus-derived lymphocyte population. They cannot, however, be demonstrated in the nonthymus-derived population in the system used here. These findings are discussed with reference to the nature of the interaction that takes place between the two classes of lymphoid cells. (auth)

25412 SCHISTOSOMA-MANSONI: STAGE SPECIFICITY OF GRANULOMA FORMATION AROUND EGGS AFTER EXPOSURE TO IRRADIATED CERCARIAE, UNISEXUAL INFECTIONS, OR DEAD WORMS. Warren, Kenneth S.; Domingo, Ernesto O. (Case Western Reserve Univ., Cleveland). Exp. Parasitol.; 27: 60-6(1970).

Humoral antibody-mediated immediate hypersensitivity responses are relatively nonspecific in comparison with cell-mediated delayed hypersensitivity reactions as has been demonstrated in both in vivo and in vitro systems. Studies of both antibody formation and immediate intradermal reactions in schistosomiasis have shown marked cross-reactivity between schistosomes and other helminths, among the three major human schistosome species, and among the different stages of development of individual schistosome species. The recent demonstration that the schistosome egg granuloma is a form of cell-mediated delayed hypersensitivity has resulted in a series of investigations of the specificity of this reaction. It was initially shown that there was no cross-reactivity between *Schistosoma mansoni* and *Ascaris suis* eggs. Then it was found that there was relatively little cross-reactivity among the eggs of the three human schistosome species, and finally, mice with early schistosomiasis, prior to the onset of egg laying by the worms, were not sensitized to granuloma formation around homologous eggs. In the present study mice were each exposed to 1000 irradiated *S. mansoni* cercariae (10,000 R), were unisexually infected with large numbers of male or female *S. mansoni* worms, or were injected intraperitoneally with killed 4-week-old worms of the same species. *S. mansoni* eggs isolated from the livers of mice with schistosomiasis mansoni of 8 weeks' duration were injected intravenously into the lungs of experimental mice. In comparison with control unsensitized mice and mice sensitized with homologous eggs in which markedly accelerated and augumented granuloma formation occurred, the mice exposed to irradiated cercariae, those with unisexual infections, and those injected with killed 4-week-old worms all acted as unsensitized animals. The cell-mediated delayed hypersensitivity granulomatous reaction which develops around *S. mansoni* eggs appears to be a stage-specific reaction. (auth)

25413 EFFECT OF COLD EXPOSURE ON SERUM THYROTROPIN. Hershman, Jerome M.; Read, Dale G.; Bailey, Anne L.; Norman, Victor D.; Gibson, Timothy B. (Veterans Administration Hospital, Birmingham, Ala. Univ. of Alabama, Birmingham). J. Clin. Endocrinol. Metab.; 30: 430-4(Apr 1970).

To study the effect of cold exposure on serum thyrotropin, normal male volunteer subjects were exposed to 2 to 4 C and blood samples were obtained every 10 min for 1 hr. Serum TSH measured by radioimmunoassay did not change in 14 subjects. Administration of large doses of dexamethasone, testosterone propionate and conjugated equine estrogen separately or combined did not alter the TSH level in response to this cold exposure. Several hypothermia in 11 patients undergoing open heart surgery failed to elevate serum TSH. In rats exposed to 3-4 C for 30 and 240 min, there was a significant increase in serum TSH measured by both bioassay and radioimmunoassay. The results indicate that acute cold exposure in man will not serve as a test of the integrity of the hypothalamic-pituitary TSH axis or as a means of testing pituitary thyrotropin reserve. (auth)

25414 MAMMALIAN HOMOLOGUE OF THE AVIAN BURSA OF FABRICIUS. II. EXTIRPATION, LETHAL X-IRRADIATION, AND RECONSTITUTION IN RABBITS. EFFECTS ON HUMORAL IMMUNE RESPONSES, IMMUNOGLOBULINS, AND LYMPHOID TISSUES. Perey, Daniel Y. E.; Frommel, Dominique; Hong, Richard; Good, Robert A. (Univ. of Minnesota, Minneapolis). Lab. Invest.; 22: 212-27(Mar 1970).

The available clinical and experimental evidence supporting the two-component concept of the mammalian lymphoid system is reviewed. The postulate that the gut-associated lymphoid tissues (GALT) of mammals represent the functional homologue of the avian bursa of Fabricius is presented and further tested. Rabbits, 1-month-old, were subjected to one of several procedures whereby GALT or equivalent amounts of other lymphoid tissues were extirpated. After 1 month the animals were given both primary and secondary antigenic stimuli, lethally x-irradiated within 24 hours, and immediately reconstituted with hemopoietic stem cells from the liver of rabbit fetuses. Rabbits lacking GALT were incapable of responding to a primary antigenic stimulation (*Brucella abortus*) but showed normal secondary responses (*B. abortus* and sheep erythrocytes). These same animals failed to repopulate thymus-independent areas in lymph nodes and spleen. Removal of GALT was followed by a pronounced rise in circulating immunoglobulin M (IgM) after stimulation; this was substituted by a prolonged fall in IgM when x-irradiation and reconstitution were added. It is concluded that GALT give rise to newly differentiated immunocompetent cells, which first participate in a humoral response by synthesizing IgM antibodies, and thus seem homologous to the bursa of Fabricius of birds. (auth)

25415 IMMUNOLOGIC RESPONSE OF SWINE TO X-IRRADIATED LARVAE OF ASCARIS SUUM. Leidahl, Gordon Arthur. Lincoln, Neb.; Univ. of Nebraska (1969). 113p.

Thesis.

Immunity to many helminths can be induced by repeatedly dosing the host with infective stages. Because extensive tissue damage is incurred, it is not practical to use this method of immunization when the helminth has a visceral migration. Irradiation larvae of several helminths are able to induce high levels of immunity without significantly harming their hosts. This method of immunization depends upon a tissue migration by the helminth so that the host is well exposed to antigens. Since there is an extensive visceral migration during the early infection with *Ascaris suum* (Goeze, 1782), this method of immunization may be applicable to the immunization of swine against *A. suum*. The dose of x irradiation necessary to prevent larvae of *A. suum* from reaching the lung phase of their migration and the nature of the immunity ininduced in swine by larvae exposed to this dosage were investigated. In the first experiment (15 pigs), the experimental group (6 pigs) received infective eggs that were irradiated with 30,000 R of x ray. In the next major experiment (14 pigs), the experimental group (6 pigs) received infective eggs that were irradiated with 350,000 R of x ray. The nature of the immunologic responses are reported as resistance to reinfection, severity of clinical signs, level of circulating eosinophils, extent of lung and liver damage, and serum anti-ascaris antibody levels. Comments are also made on the time of release of functional antigens and the positions of immunologic barriers that larvae of *A. suum* must traverse. Pigs that received initial oral doses (Day 0) of 50,000 irradiated (30,000 R) infective eggs of *A. suum* and challenge doses (Day 22) of 50,000 nonirradiated infective eggs had responses similar to the responses of pigs that received initial (Day 0) and challenge (Day 22) doses of 50,000 nonirradiated infective eggs. Pigs that received initial oral doses (Day 0) of 10,000,000 irradiated (350,000 R) infective eggs of *A. suum* and challenge doses (Day 14) of 50,000 nonirradiated infective eggs had responses that were different than the responses of pigs that received initial (Day 0) and challenge (Day 14) doses of 50,000 nonirradiated infective eggs. Pigs that received irradiated infective eggs did not have clinical signs of ascariasis after initial doses, and most pigs had only mild to moderate clinical signs after challenge doses. Eosinophilic responses were not as great and occurred more rapidly in the pigs receiving irradiated infective eggs than in the pigs receiving nonirradiated infective eggs. Tissue damage was absent or negligible following initial doses of irradiated infective eggs. Following challenge doses, the pigs receiving irradiated infective eggs had greater lung damage but less liver damage than pigs receiving nonirradiated infective eggs. Clinical signs of ascariasis were not observed in any of the pigs following initial doses. Following challenge doses, the pigs receiving irradiated infective eggs had mild to moderate signs of ascariasis. Pigs that received irradiated infective eggs had antibody responses similar to the antibody responses of pigs that received nonirradiated infective eggs as determined by the Conglutinating Complement Absorption Test. (Disser. Abstr.)

25416 INFORMATION TRANSFER IN THE IMMUNE SYSTEM. Wegmann, Thomas George. Madison, Wis.; Univ. of Wisconsin (1969). 114p.

Thesis.

An attempt was made to better understand the flow of both cells and information for the synthesis of gamma globulin to and from the various immune organs during the development of the immune response, as well as to probe the nature of these cells. The differentiation of the thymus in a foreign environment was examined. The 12 day old fetal thymus will differentiate when placed into the anterior chamber of the eye of an isogenic adult mouse, but not if the host mouse is of a different strain. It was shown that this failure to differentiate is a standard histocompatibility reaction that can be mediated by the H-2 locus, despite the rapidity of the reaction and its occurrence in the anterior chamber of the eye, an immunologically protected site. Cortisone damage to the thymus and to the immune response following irradiation was studied to see if this chemical is the mediator of post-irradiation immune damage, and also to examine the relation between the thymus and the immune response. The results indicate that prior adrenalectomy does not increase the number of spleen cells making antibody to cow red cells following irradiation, nor does it enhance the subsequent recovery. However, the surgery itself increased the ability of the unirradiated animals to respond to the antigen. The modified Jerne technique employed in these experiments detected partial immune recovery ten days after irradiation, a result in contrast to earlier work in which no recovery was detected during this period. These results are discussed in terms of the role of the thymus following irradiation. The contribution of the developing fetal thymus to the resultant immune system was investigated in terms of cells and the information for antibody synthesis. Fetal thymuses taken from mice at the 13th day of intrauterine gestation were grafted into fetal mice at the same stage of development, who differed from the donors at the locus for 7S gamma 2A globulin (the Ig-1 locus) as well as by a chromosome marker (the donors had the T6 centric radiation fragment). One host had a thymus graft that was found upon autopsy at 1½ months of age. It had no detectable (<1%) gamma globulin of donor type, but 5% of the metaphases examined in the bone marrow were of donor type. A similar experimental design was attempted in rabbits, but it failed. The implications of these findings are discussed. Experiments defining the relation between the hemoglobin-producing and gamma globulin-producing systems are described. Mice containing the cells of two inbred strains were generated by fusing two eight cell stage embryos, one C57Bl/10SNJ and one C3H/HeJ, and allowing them to come to term. The two strains used differ at the locus for 7S gamma 2A globulin (Ig-1 locus), as well as the locus for the beta chain of hemoglobin. The relation between the two cell lines that produce these proteins was examined by comparing the degree of chimerism for one system to the other, and the degree of chimerism of both of them to that for coat color. The results indicate that the systems responsible for gamma globulin and hemoglobin are tightly correlated. (Disser. Abstr.)

25417 THE METABOLISM OF DIFFERENT IMMUNOGLOBULIN CLASSES IN IRRADIATED MICE. II. ROLE OF THE GUT. Bazin, H.; Maldague, P.; Heremans, J. F. (Cliniques Univ. St.-Pierre, Louvain, Belgium). Immunology; 18: 361-7 (Mar 1970).

Adult C_3H mice were x irradiated by 700 R in toto or with the gut shielded. In similar experiments the gut alone was irradiated The earlier observation of a selective and profound decrease of serum IgA, moderate decrease in IgG_1 and IgG_2, and little change in IgM, was confirmed for the animals irradiated without protection of the gut. Similar effects were found when the gut alone was irradiated, whereas whole-body irradiation with the gut shielded caused only little change in the different serum immunoglobulins. Hence the characteristic responses of the serum immunoglobulins appeared to result from x ray damage to the intestine. From this and a preceding study it was hypothesized that such damage resulted in moderate losses of IgG from the blood stream into the intestinal lumen, but that the selective and severe depression of serum IgA was mostly caused by the escape, through the damaged epithelium, of that portion of the secretion from intestinal plasma cells which normally would have joined the blood stream. (auth) (UK)

25418 EFFECT OF SOME STIMULANTS OF NONSPECIFIC PROTEOSYNTHESIS ON THE ANTIBODY SYNTHETIC ACTIVITY OF HEPATIC AND SPLENIC EXPLANTS OF IMMUNIZED AND IRRADIATED RABBITS. Zolotnikova, G. P. Zh. Mikrobiol., Epidemiol. Immunobiol.; No. 2, 97-102(Feb 1969). (In Russian).

The effect of various stimulants of nonspecific protein synthesis on the antibody titer in cultures of surviving hepatic and splenic tissue of immunized rabbits was studied. Unlike the splenic explants, hepatic explants had no antibody synthesizing activity on medium 199 without addition of stimulants. In a culture of surviving hepatic tissue obtained from healthy rabbits the antibody titer against Mechnikov's vibrio rose more in the presence of glucose; when the tissue was from irradiated animals, the presence of choline increased this titer. (Excerpta Med.)

25419 ENHANCED PHAGOCYTIC FUNCTION IN VIVO AFTER WHOLE BODY IRRADIATION. Sljivic, V. S. (Medical Research Council, Harwell, Eng.). Experientia; 26: 83-4(15 Jan 1970).

Mice were irradiated with 600, 800, or 1000 rads of x-rays. Seven or fifteen days later, they were injected with colloidal carbon or non-living Escherichia coli labelled with ^{51}Cr. In comparison to control animals, the injected particles disappeared more rapidly in the irradiated ones. Distribution studies showed that the particles were removed by the activity of the reticuloendothelial system, especially that of the liver. Increased permeability of the circulatory system was excluded as a major contributing factor. (H.B.G.)

25420 HYPOTHERMIA, RADIATION, AND THE IMMUNE RESPONSE. Yin, Eunice; McKenna, J. M.; Musacchia, X. J. (Univ. of Missouri, Columbia). Proc. Soc. Exp. Biol. Med.; 133: 1207-11(Apr 1970).

An adverse effect of hypothermia for 18 hr to the immune response was observed in hamster sera up to 10 days after primary immunization with Influenza A virus vaccine. Hypothermia caused less inhibition to the secondary response than did radiation, while 2000 R completely destroyed the primary response of both active and hypothermic hamsters. Hypothermia under the conditions described did not afford any protection to the radiosensitivity of either the primary or the secondary immune response. The combination of hypothermia and radiation seemed to act synergistically in lowering the immune response. The presence of both IgG and IgM was shown in the sera of all the groups used in the primary response studies. IgM seemed to be the predominant immunoglobulin in the HI test. (auth)

Ecology

Refer also to abstracts 25293, 25471, 25472, 25476, and 25580.

25421 (A-AC-82/G/L-1302) SOME PATTERNS OF DISTRIBUTION OF MAJOR RADIOACTIVE FISSION PRODUCTS DEPOSITED FROM THE ATMOSPHERE IN GLOBAL FALLOUT IN FORESTS OF VARIOUS AREAS OF THE USSR DURING THE PERIOD 1964–1965. Molchanov, A. A.; Fedorov, E. A.; Aleksakhin, R. M.; Aleksakhina, M. M.; Mishenkov, N. N.; Naryshkin, M. A.; Tyumenev, L. N.; Ukhanova, V. A.; Yulanov, V. P. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). 1968. 10p. (In Russian). Dep. CFSTI (U. S. Sales Only).

Samples of forest litter and of different parts of trees were selected in a number of forests of the European part of the USSR in the autumn of 1964 to 1965. The samples were ashed at 500°C, and analyzed radiochemically for strontium-90, zirconium-95, niobium-95, ruthenium-106, cesium-137, and cerium-144. The highest concentration of fission products was noted in the forest litter, while the lowest was found in the tree wood. The tree parts such as needles, leaves, bark, branches, and roots occupy an intermediate position with a concentration of 10^{-9} to 10^{-10} curies/kg of air-dried material. The radionuclide concentration in the tree wood is a factor of 10 to 100 lower, while the concentration is a factor of 10 higher in the forest litter. (TTT)

25422 (BMI-171-34) DARIEN FISH POLYCLAVE. Bioenvironmental and Radiological-Safety Feasibility Studies, Atlantic-Pacific Interoceanic Canal. Duke, James A. (Battelle Memorial Inst., Columbus, Ohio). 12 Mar 1970. Contract AT(26-1)-171. 60p. Dep. CFSTI.

An ecological study of fish was conducted in connection with feasibility studies for the proposed sea-level canal to be constructed with the aid of nuclear explosives. An overlay information-retrieval system is presented for economically important fish species. The overlay predicts which species are more likely to cross the canal and which species are more likely to find a niche in the Atlantic if they traverse the proposed canal from the Pacific. Data reveal that fish species show a wide range of tolerance of habitats, salinities, and turbidity; these species are more likely to cross a canal than those with narrow tolerance. (H.L.W.)

25423 (BMI-171-35) DARIEN GASTROPOD POLYCLAVE. Bioenvironmental and Radiological-Safety Feasibility Studies, Atlantic–Pacific Interoceanic Canal. Duke, James A. (Battelle Memorial Inst., Columbus, Ohio). 31 Mar 1970. Contract AT-(26-1)-171. 75p. Dep. CFSTI.

An ecological study of gastropods was conducted in connection with feasibility studies for the proposed sea-level canal to be constructed with the aid of nuclear explosives. An inverted index is presented to the occurrence of various taxonomic and ecologic attributes of the genera of gastropods found or expected in the littoral, estuarine, fresh-water, and terrestrial ecosystems of Panama. Feeding habits and transport of gastropods through the proposed canal are discussed with relation to their ecological significance. (H.L.W.)

25424 (BMI-171-36) DARIEN PELECYPOD POLYCLAVE. Bioenvironmental and Radiological-Safety Feasibility Studies, Atlantic-Pacific Interoceanic Canal. Duke, James A. (Battelle Memorial Inst., Columbus, Ohio). 2 Apr 1970. Contract AT-(26-1)-171. 43p. Dep. CFSTI.

An ecological study of pelecypods was conducted in connection with feasibility studies for the proposed sea-level canal to be constructed with the aid of nuclear explosives. An overlay information-retrieval system for taxonomic identification of 300 genera of pelecypods is presented. The data indicated that the pelecypods were insignificant as potential hazards if introduced into the opposite side of the Isthmus and that important food species in the Isthmian region would not be endangered by transit of pelecypods. (H.L.W.)

25425 (BNWL-CC-547) USE OF WATER AS A SAMPLING MEDIUM FOR TRITIUM OXIDE. McConnon, D. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). [nd]. Contract AT(45-1)-1830. 13p. Dep. CFSTI.

A sampling technique for airborne tritium oxide was developed and tested. Under the experimental conditions considered, the efficiency of this method averaged 98%. The technique employs a gas wash bottle filled with ordinary distilled water through which air is bubbled at a constant flow rate. The method is rapid, reliable, and sensitive and has been proven under a variety of field conditions. The minimum detectable tritium oxide air concentration that can reliably be measured is 1×10^{-7} μCi/cc. Additionally, a technique is described for determining the amount of tritium oxide surface contamination. Because of difficulties in measuring the collection efficiency of the technique, it is presently used for qualitative measurements as a trend indicator only. (auth)

25426 (CEA-R-3861) A STUDY OF INTERNAL CONTAMINATION LEVELS RESULTING FROM ^{90}Sr AND ^{137}Cs ENVIRONMENTAL POLLUTION. THE INFLUENCE OF DIFFERENT FACTORS. Garnier, Arlette (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Feb 1970. 101p. (In French). (EUR-4146). Dep. CFSTI (U. S. Sales Only).

In the first part of this study, the amounts of ^{90}Sr and ^{137}Cs dietary intakes are evaluated as a function of age with a view to assessing internal exposure doses and estimating the critical age. The relative influence of the contamination transfer factors and of the various types of diets are studied. The results of both the dietary surveys made in 11 regions of the European Community giving the evolution of the consumed amounts of 13 groups of foodstuffs, as a function of age, and the mean factors of contamination transfer are used. In the second part, internal exposure doses are assessed as a function of age under a prolonged exposure on the basis of the preceding results and radiobiological data. The body burdens and mean doses (either to the skeleton or the whole body according to the radionuclides) originating either from a unitary exposure (exclusively of direct or indirect type) or from a contamination implying both modes of exposure are evaluated. As only the diets vary with the regions, the results reflect their influence. The results should be corrected for the influence of the human and transfer factors for a more accurate assessment of the dose variation. (France)

25427 (NP-18200) RESPONSES TO ELEVATED TEMPERATURE OF FISHES NEAR PRESCOTT, OREGON IMPORTANT TO THE COMMERCIAL OR SPORT FISHERY OF THE COLUMBIA RIVER. Supporting Final Report Observations. Coutant, C. C. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). May 1968. 40p.

For Portland General Electric Co., Oreg.

Studies were conducted on responses to elevated temperature of fishes (sockeye, chum, chinook, and pink salmon and rainbow trout) relative to siting a nuclear electricity generating station on the lower Columbia River near Prescott, Oregon. Tables are presented to show median resistance times to high temperature among different species of fish. The possibilities for interaction of temperature and other physical factors of the environment, and of temperature with biological processes were investigated. Some factors studied were oxygen availability, salinity, interaction of temperature, and supersaturated gases, susceptibility to poisons, susceptibility to disease, and susceptibility to predation. Temperature sensitivity of reproductive activities such as spawning, incubation, and rearing is discussed with relation to reduction in population size. (H.L.W.)

25428 (NYO-2579-19) RADIOECOLOGY OF SMALL VERTEBRATE SPECIES UNDER NATURAL ENVIRONMENTS. Progress Report, December 1, 1968-November 30, 1969. Tryon, C. A. (Pittsburgh Univ., Pa.). Contract AT(30-1)-2579. 22p. Dep. CFSTI.

Population dynamics, type and intensity of activities, availability and ingestion of food, and effects of radiation were investigated using the chipmunk (Tamias striatus) and the pocket gopher (Thomomys talpoides). Data on 1600 chipmunks captured on plots at two locations in Pennsylvania were stored on computer tape. Data were analyzed for estimates of home range, center of activity, relative activity, and effects of treatments. Estimates of work energy associated with the major types of chipmunk behavior were obtained with the aid of a miniaturized transducer and transmitter. Basic ecological research on the pocket gopher was carried out in the Beartooth Mountains in Wyoming. For studies on effects of radiation on populations under natural conditions, gophers and chipmunks were exposed to 200 and 400 R of γ radiation. Results indicated that radiation lowered the fertility of the gopher population; without the influx of the young the older members were able to maintain their position in the population. Effects on chipmunks indicated that life expectancy was reduced without changing the slope of the age-specific mortality curve. (H.L.W.)

25429 BIRD POPULATIONS AT ENIWETOK ATOLL. Carpenter, Michael L.; Jackson, William B.; Fall, Michael W. (Bowling Green State Univ., Ohio). Micronesica; 4: 295-307 (Dec 1968). (COO-1485-18).

Observations of bird diversity and populations were made at Eniwetok Atoll during portions of 1964, 1965, 1966, and 1967; populations were found to differ markedly from those previously reported for the atoll. While some differences in the number of migratory or wandering birds were noted, the principal decrease was in the resident species. Vegetational recovery and growth were probably responsible for a shift in the nesting site of one tern species but did not seem to be responsible for the reduction of the other species. No adequate explanation could be discovered. The breeding cycle of Sooty Terns (Sterna fuscata) on Eniwetok was reviewed and found to be irregular. (auth)

25430 CHALLENGE FOR SURVIVAL. LAND, AIR, AND WATER FOR MAN IN MEGALOPOLIS. Conference Held at New York, April 25-26, 1968. Dansereau, Pierre (ed.). New York; Columbia University Press (1970). 247p. $7.95. (CONF-680424).

Fourteen papers were presented. A separate abstract was prepared for one. The thirteen remaining papers deal with various aspects of pollution of air, land, and water. (H.B.G.)

For an abstract of one paper see: 25431.

25431 RADIOACTIVITY AND FALLOUT: THE MODEL POLLUTION. Woodwell, George M. (Brookhaven National Lab., Upton, N. Y.). pp 159-69 of Challenge for Survival. Land, Air, and Water for Man in Megalopolis. /Dansereau, Pierre (ed.). New York; Columbia Univ. Press (1970).

From Symposium on Challenge for Survival. Land, Air, and Water for Man in Megalopolis, New York. See CONF-680424.

The problem of releasing both radioactive and chemical toxic material into the environment is discussed with respect to hazards to populations. Commonly, the environment is assumed to be large enough for toxic materials to dilute into innocuousness. On a worldwide scale, this assumption is questioned with respect to various isotopes such as ^{137}Cs, ^{90}Sr, and ^{55}Fe and with regard to various persistent pesticides, especially DDT. (H.B.G.)

25432 WATER POLLUTION. Lumb, C. pp 29-51 of Technological Injury. /Rose, J. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1969).

The principal uses of water resources are enumerated, whether these depend on abstractions from sources of supply or uses in situ. Water quality requirements for the various usages are discussed. Expanding consumption of water is likely to lead to future demands that can only be met by increasing abstraction from the lower reaches of rivers at the same time as these rivers are called upon to absorb greater volumes of used effluents. The principal sources of pollution of water resources arising from technological developments include sewage effluents, waste waters both from industries of all types and from agriculture, oil contamination, the effects of products such as synthetic detergents, pesticides and herbicides, radioactive contamination, and accidents from the transport of dangerous or polluting substances. The need for controlling pollution is discussed and the legal position in Great Britain summarized. The pollution of water resources is becoming of worldwide concern, and poses a problem the solution of which is becoming urgent. (auth)

25433 TECHNOLOGICAL INJURY. THE EFFECT OF TECHNOLOGICAL ADVANCES ON ENVIRONMENT, LIFE, AND

SOCIETY. Rose, J. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1969). 240p.

Separate abstracts were prepared for two of the chapters in this book. The chapters are divided into two parts which deal with pollution of the environment and the effects on society and life respectively. The chapters in the first part discuss man and his environment, air pollution, water pollution (see separate abstract), pollution of outer space, radioactive wastes (see separate abstract), drugs in animal feeds, and pesticides. The chapters in the second part discuss the effects of drugs, genetic adaptation, computers, transportation, noise, psychological stress, leisure, and the effect of technical change. References are provided at the end of each chapter and a combined author and subject index is included. (E.R.B.)

25434 ANALYSIS OF ^{55}Fe PRODUCED BY NUCLEAR TESTS AND ITS ENRICHMENT IN FINNISH LAPPS. Jaakkola, Timo (Univ. of Helsinki). Ann. Acad. Sci. Fenn., Ser. A II; No. 150, 64p(1969).

To determine ^{55}Fe in biological material, a method was developed in which dried samples were wet oxidized, using nitric acid and perchloric acid, after which iron was isolated by diisopropyl ether extraction and cation exchange. To determine the radioactivity of ^{55}Fe, the iron was electrodeposited on a copper plate. The radioactivity was determined with a 2 π gas flow proportional counter. The determinations of inactive iron needed for ^{55}Fe determinations were carried out with an atomic absorption spectrophotometer. There was a great increase in the ^{55}Fe content of plants from 1962 to 1963. The ^{55}Fe content of willow and birch leaves and of grass (*Deschampsia flexuosa*) reached maximum levels (88.5, 85.6, and 54.6 nCi/kg dry wt, respectively) in 1963. The ^{55}Fe content of lichen (*Cladonia alpestris*) reached its maximum level (96.3 nCi/kg dry wt) one year later, i.e., in 1964. The effective half-life of ^{55}Fe in lichen (*Cl. alpestris*) was 1.4 years. Using this value, the biological half-life of ^{55}Fe obtained for lichen was 2.9 years. The ^{55}Fe content of reindeer meat was highest, 7.5 nCi/kg fresh weight, in the spring of 1965. In spring 1965, the specific activity of ^{55}Fe in reindeer meat and blood was 224 pCi/mg Fe and 332 pCi/mg Fe, respectively. 150 days were estimated to be the biological half-life of ^{55}Fe in reindeer blood. The ^{55}Fe content of the blood of the Lapps in March 1966 was 10.6 to 22.2 nCi/l blood for the men and 16.5 to 35.1 nCi/l blood for the women. These ^{55}Fe contents corresponded to whole body burdens of 92 to 167 nCi for men and 101 to 260 nCi for women. The specific activity of ^{55}Fe in blood (pCi/mg Fe) in women of fertile age was about twofold that in men. The highest blood ^{55}Fe content, 69.7 pCi/mg Fe, was recorded for the women of the reindeer-herding group in Inari. The highest ^{55}Fe value in the blood of Lapp males, 48.1 pCi/mg Fe, was recorded in Sevettijärvi Skolt Lapps in the age group 8 to 10 years. Over 98% of ^{55}Fe in the diet of the Sevettijärvi and Inari Lapps originated from reindeer meat, liver, and blood. Depending on sex and occupation group, 6 to 15% of the ^{55}Fe in the diet of the Utsjoki Lapps was derived from salmon and cod caught in the Arctic Ocean. The ^{55}Fe content of the salmon was 1,020 pCi/mg Fe (4.6 nCi/kg fresh weight) and that of the cod 236 pCi/mg Fe (0.87 nCi/kg fresh weight) in the autumn of 1966. Depending on the occupation group, the total amount of ^{55}Fe in the diet in spring 1966 varied in the Lapp men from 1,500 to 4,700 pCi per day and in the women from 1,500 to 1,800 pCi per day. The body burden of ^{55}Fe in Lapps in the spring of 1966 varied from 0.07 to 0.26% of the maximum permissible body burdens recommended by ICRP. In the different Lapp groups the annual absorbed dose for the whole blood ranged from 1.1 to 3.7 mrad, and for erythrocytes from 1.9 to 6.6 mrad. (auth)

25435 CONTENT AND DISTRIBUTION OF LONG-LIVED FISSION PRODUCTS IN THE UPPER VOLGA RESERVOIRS. Bylinkina, A. A. pp 229-39 of Khimizm Vnutrennikh Vodoemov i Faktory Ikh Zagryazneniya i Samoochishcheniya. /Kuznetsov, S. I. (ed.). Leningrad; Izdatel'stvo Nauka Leningradskoe Otdelenie (1968). (In Russian).

Measurements were made of the distribution of radioactive fallout washed from the surface by snow into the upper Volga in the Ivanovskii, Uglich, Rybinsk, and Gor'kii region during 1965. The analysis of the basins showed the highest concentration of β activity in the fine silts at the bottom. The amount of ^{90}Sr and ^{137}Cs was relatively low in comparison to the content of cerium, which was considerably higher. (R.V.J.)

25436 KHIMIZM VNUTRENNIKH VODOEMOV I FAKTORY IKH ZAGRYAZNENIYA I SAMOOCHISHCHENIYA. (Chemism of Inland Waters and Factors of Their Pollution and Purification). Kuznetsov, S. I. (ed.). Leningrad; Izdatel'stvo Nauka Leningradskoe Otdelenie (1968). 255p.

Sixteen articles are included on contamination of water of Upper Volga reservoirs, pollution factors producing the contamination, and self-purification of reservoirs. Contamination by β activity from fallout washed into the reservoirs by snow is also discussed. A separate abstract was prepared for one article of special interest. (R.V.J.)

25437 FALL-OUT ^{137}Cs IN BREAST- AND BOTTLE-FED INFANTS. Rundo, J. (Atomic Energy Research Establishment, Harwell, Eng.). Health Phys.; 18: 437-8(Apr 1970).

Comparisons have been made of the cesium-137 concentration in infants both breast- and bottle fed and, in two cases, for both types of feeding in the same infant. The concentrations in the mothers were also measured. The cesium-137 concentration in a breast-fed baby never exceeded that in its mother but the reverse was true in bottle-fed babies. (UK)

25438 OCCURRENCE OF ^{22}Na IN MEDIUM-SIZED MAMMALS. Gabay, Jack J.; Daly, James C.; Sax, N. Irving (Dept. of Health, Albany). Health Phys.; 18: 429-31(Apr 1970).

During a radioecological range finding study in the vicinity of a nuclear fuels reprocessing plant located in the southwestern part of New York State and in the Albany, N. Y., area a wide variety of flora and fauna were analyzed of which raccoon, woodchuck and opossum showed small concentrations of ^{22}Na and ^{137}Cs. Comparison of ^{22}Na to ^{137}Cs ratios with those reported by DeBortoli et al (NSA 20: 16678) show the present samples to have enhancement factors one to two orders of magnitude greater and thus a higher degree of ^{22}Na concentration. The reasons for this and the mechanism of ^{22}Na uptake are discussed. (UK)

Genetics and Cytogenetics

Refer also to abstracts 25410, 25548, 25598, and 25599.

25439 (CONF-700205-1) BIOLOGICAL DOSIMETRY IN AN INDUSTRIAL RADIOGRAPHY ACCIDENT. Brown, J. K.; McNeill, J. R. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). 1970. 10p. Dep. CFSTI (U. S. Sales Only).

From 2nd Human Cytogenetics Conference, Sydney, Australia.

A biological assessment was made of the doses of radiation received by two healthy adults accidentally exposed to a 22-curie ^{192}Ir source. Each subject had the same number of dicentric chromosome aberrations in short term peripheral blood cultures at both the 8th and 21st day after exposure. The frequency of dicentrics for each subject was equivalent to an in vitro dose of 25 rem. The corresponding film badge reading was 22 rem for one subject. Analysis of the results suggests that the method can be utilized to give a reasonable estimate of low exposure levels of radiation provided an adequate size chromosome example is examined.

25440 (NYO-4080-1) BIOLOGICAL AND CHEMICAL STUDIES ON PHYSICAL MUTAGENS. Progress Report, April 1, 1969–March 31, 1970. Person, Stanley (Pennsylvania State Univ., University Park. Dept. of Biophysics). Jan 1970. Contract AT(30-1)-4080. 18p. Dep. CFSTI.

The distribution into classes of *Escherichia coli* revertants produced by either ^{60}Co γ radiation or by the radioactive decay of tritium- or ^{14}C-labeled molecules and atoms was compared and a rapid and quantitative method for determining the specificity of a revertant at the level of a single DNA base substitution is described. The following facts were concluded or inferences drawn. The decay of tritium-labeled molecules can produce mutations by a number of DNA base changes, no single base substitution being predominant. The lethal effects, as well as the reversion frequencies, induced by the decay of ^{14}C-labeled molecules can be attributed to radiation damage, but about eight times as many ^{14}C decays as tritium decays are required to produce lethality. A non-radiation component of killing (4X) and mutation (9X) was observed. Since lethality was not necessarily caused by a genetic coding substitution, and since the non-radiation components of killing and mutation differed from each other, the molecular events causing lethality and reversion may differ. (E.R.B.)

25441 (ORNL-TM-2912) NEUROSPORA EXPERIMENT P-1037. Final Report to the National Aeronautics and Space Administration. (Oak Ridge National Lab., Tenn.). Mar 1970. 24p. Dep. CFSTI.

Genetic effects of space flight alone and space flight in combination with known doses of radiation on Neurospora were investigated during Gemini XI and Biosatellite II missions. On the Biosatellite II mission a ^{85}Sr gamma ray source was used; on the Gemini XI mission a ^{32}P beta ray source was used. Comparisons were made between flight and ground-control dose-response curves. In the Biosatellite II experiment *Neurospora conidia* were tested while collected on the surface of Millipore filters; in the Gemini XI experiment they were tested both while collected on the surface of Millipore filters and while in a colloidal suspension of agar. The data from the Biosatellite II experiments show that there was no difference between the flight and ground-control survival curves nor between flight and ground-control curves for the overall induction of ad-3 mutations. The data from the Gemini XI experiments show that the space flight affected the samples flown on Millipore filters in the same way as on the Biosatellite II mission. However, data from samples flown in suspension showed higher levels of survival and lower frequencies of mutation induction. Space flight gave protection against both effects of radiation on samples in suspension. (H.L.W.)

25442 LOCATION OF GENES CONTROLLING EXCISION REPAIR OF UV DAMAGE AND MUTATOR ACTIVITY IN ESCHERICHIA COLI WP2. Hill, Ruth F. (York Univ., Downsview, Ont.). Mutat. Res.; 9: 341-4(Mar 1970).

Male and female strains of Escherichia coli WP2 were mixed in an Erlenmeyer flask. The mixture was centrifuged and resuspended in phosphate buffer; appropriate dilutions were then plated on selective media. Plates were uv-irradiated with a dose of 85 erg/mm^2. A high mutation rate to azide resistance was indicated. Tables are presented to show genetic analysis of recombinants from mating of HB42 with RH5354 and of HfrH with RH5354. Results make it possible to establish the location of the mutant gene. (H.L.W.)

25443 BIOLOGICAL SIGNIFICANCE OF INDUCED HUMAN CHROMOSOME ABERRATIONS. Nowell, Peter C. (Univ. of Pennsylvania, Philadelphia). Fed. Proc.; 28: 1797-1803(Nov-Dec 1969).

Human chromosome aberrations are reviewed with respect to ionizing radiation, chemicals, and both DNA and RNA viruses. Ionizing radiation has a more general effect, while the other agents damage specific chromosome sites. Possible consequences on population genetics, cancer induction, immunological disorders, and the aging process are discussed. 61 references are given. (H.B.G.)

25444 CHROMOSOME ABERRATIONS AND MALIGNANT DISEASE AMONG A-BOMB SURVIVORS. Bloom, Arthur D.; Nakagome, Yasuo; Awa, Akio A.; Neriishi, Shotaro (Univ. of Michigan, Ann Arbor). Amer. J. Public Health; 60: 641-4(Apr 1970).

Evidence is presented that: A-bomb survivors have many residual chromosome aberrations from their exposure: about 50 per cent of all persons exposed to over 100 rad may be expected to harbor these aberrations; they are capable of producing distinct subpopulations of cytogenetically aberrant cells in vivo; and the proportion of aberrant cells is dose- and age-dependent. While these aberrations per se are not indicative of any radiation-induced disease, their potential relationship to neoplasia is important. The long-term, continued medical and cytogenetic surveillance of the A-bomb survivors will hopefully tell us whether or not induced aberrations, whether viral, drug, or radiation produced, are of biological importance to man. (auth)

25445 CHROMOSOMAL ABERRATIONS OF THE LEUCOCYTES REMAINING AFTER IRRADIATION FOR CANCER OF THE FEMALE GENITAL ORGANS. Nappi, R.; Scoppetta, V.; Curcio, S. (Univ., Ferrara, Italy). Arcisp. S. Anna di Ferrara; 21: 313-18(1968). (In Italian).

Chromosome aberrations persisting several years after treatment, were shown in four patients treated by radiotherapy for uterine or ovarian cancer. The possible meaning of such aberrations is discussed. (Excerpts. Med.)

25446 PIGMENTED VARIANTS OF RHIZOBIUM. ISOLATION, GENETICAL CONSTITUTION, HEAT- AND U.V.-RESISTANCE. Gillberg, Bjoern O. (Royal Agricultural Coll. of Sweden, Uppsala). Arch. Mikrobiol.; 69: 260-5(1969).

Non-infective pigmented variants of Rhizobium were isolated from several cultures after treatment with antibiotics, heat and uv irradiation. These variants tolerated much higher doses of heat, uv radiation and certain antibiotics than the wild type strains from which they originated. Some of the pigmented variants produced reverse mutants on subculture that had lost their pigment but recovered their infectivity. These reverse mutants also lost their extreme uv resistance. However, many pigmented mutants were very stable and reverted only after uv irradiation. It was shown from the investigation that pigmentation in Rhizobium and loss of ability to form nodules on the roots of leguminous plants are genetically linked and may be pleiotropic effects. So far, more than 10 pigmented variants have been isolated, none of them was infective, while reverse mutants that had lost their pigment always gave rise to nodules. (auth)

25447 THE CYTOLOGICAL EFFECTS OF SPACE FLIGHT FACTORS, VIBRATION, CLINOSTAT, AND RADIATION ON ROOT TIP CELLS OF TRADESCANTIA. Marimuthu, K. M.; Sparrow, A. H.; Schairer, L. A. (Brookhaven National Lab., Upton, N. Y.). Radiat. Res.; 42: 105-19(Apr 1970).

Cytological effects of actual and simulated space flight factors, with and without γ irradiation, were studied in Tradescantia clone O2. In the Biosatellite II experiment, one package of 32 rooted Tradescantia inflorescences was exposed during the weightless phase to about 220 R of γ radiation from an ^{85}Sr source, and an unirradiated package was used as a flight control. Two similar packages, one irradiated and the other unirradiated, were maintained in a nonflight vehicle at the Cape Kennedy launch site as nonflight controls. The location of the roots of individual plants within the package relative to the radiation source permitted an exposure-response determination for chromosome aberrations. In the clinostat-radiation experiments, dose response data were not obtained. After the treatment, the frequencies of chromosomal aberrations and mitotic spindle abnormalities were studied in root tip cells. A comparison between the irradiated flight and nonflight samples and between the irradiated clinostat and erect materials showed no significant difference in total chromosome aberration frequency or in single or multiple break aberrations. No increase in chromosome aberration due to random vibration was observed. A significant increase in the frequency of cells having abnormal nuclei resulting from the presumed malfunctioning of the mitotic spindle was noticed in all of the flight samples over the frequency observed in the nonflight samples. No such increase was observed either in vibration or in clinostat experiments, thus suggesting an effect of weightlessness on spindle function. (auth)

25448 FRENCH AGRICULTURAL RADIOGENETICS WORK (1964-1968). Pereau-Leroy, Pierre (CEN, Cadarache, France). Bull. Inform. Sci. Tech. (Paris); No. 141, 45-53(Oct 1969). (In French).

Investigations carried out in France since 1964 in the field of radiogenetics applied to the improvement of cultivated plants are reviewed. The first part is devoted to studies dealing with general methods of using ionizing radiations and tending to come under the heading of fundamental research, while the second covers work carried out for the practical purpose of improving various plant species and making use of radio-mutagenesis. (auth)

25449 RADIATION-INDUCED CHROMOSOME ABERRATIONS IN MAN: A POSSIBLE BIOLOGICAL DOSIMETER. Heddle, John A. (Univ. of California, San Francisco). Fed. Proc.; 28: 1790-3(Nov-Dec 1969). (UCSF-10P2-80).

The human lymphocyte is useful as a biological dosimeter in determining whether or not an individual has received a significant radiation dose. Research groups may be able to make reasonable estimates in the dose range of 50 to 500 rads by adhering strictly to their standard procedures. Nevertheless, a good test has not been made in the important dose range, and there are many unknown factors that could affect the estimate. Work is currently in progress in several laboratories, so we may expect resolution of some of the problems in the next few years, including an evaluation of the usefulness of the estimate. Furthermore, estimates of the sensitivity of human chromosomes from lymphocyte data are unlikely to be much better than order-of-magnitude estimates, and extrapolation to the important meiotic cells is very risky. (auth)

25450 PARTIAL GAMETIC STERILITY INDUCED BY GAMMA IRRADIATION OF GOLDEN DELICIOUS APPLE TREES. Decourtye, L. (Institut National de la Recherche Agronomique, Angers, France). Radiat. Bot.; 10: 1-5(Feb 1970). (In French).

The pollen germination rate, changes in coloration, and number of pips per fruit were investigated in the second vegetative generation from buds of Golden Delicious apple trees irradiated with γ rays of ^{60}Co at 5 krads. Among 280 investigated trees, 35% showed a significantly reduced pollen germination associated or not with morphological anomalies. The reduction of pollen fertility was generally associated with a decrease of the mean pip number per fruit. In 30% of cases all the trees arising from the same irradiated bud showed the same deficiency, i.e., the cell in which the mutation occurred greatly contributed in restoring at least one of the apex layers. The partly degenerating meiosis of these trees suddenly increased the frequency of triploid embryos arising from egg-cells fertilized when unreduced. This gross transfer of genotype from a variety of quality is interesting to use in a breeding program when the other parent is selected only for resistance genes. One can also think that the reduced setting rate due to these gametic anomalies can diminish the expenses for thinning out varieties which, as Golden Delicious, are steadily too fructiferous. (auth) (UK)

25451 ESTIMATING THE NUMBER OF MERISTEM INITIALS AFTER SEED IRRADIATION: A METHOD, APPLIED

TO FLAX STEMS. Beard, B. H. (Dept. of Agriculture, Brawley, Calif.). Contract AT(49-7)-2021. Radiat. Bot.; 10: 47-57(Feb 1970).

Flax seeds (Linum usitatissimum L.) were irradiated with 30 kR of x rays before sowing. If possible, seeds from five basal branches (secondary stems) were harvested separately from each of the M_1 plants. The M_2 seedlings from 47,452 branches were observed for chlorophyll mutants. If mutants were found, all seedlings in that branch progeny were classified, and the M_2 mutant frequency was calculated. Normal appearing M_2 plants were harvested and the M_3 mutant frequencies were determined from the progeny of heterozygous M_2 plants. If the M_2 segregation was not significantly different from a 3 : 1 ratio, or if the M_2 and M_3 paired ratios were similar according to χ^2 and heterogeneity χ^2 calculations, respectively, the M_1 branch was considered the product of a single initial. From a total of 65 branches with chlorophyll mutants, 45 or 69 per cent were considered to be division products of a single cell initial. If the M_2 and M_3 paired mutant frequencies were significantly different, the number of cell initials contributing to the M_1 branch was estimated from a specially constructed graph. The graph was made on log – log paper by plotting the theoretical mutation frequency from a single mutated cell on the abscissa and number of cells contributing division products on the ordinate. Only three per cent of the branches were descended from five or more cell initials. (auth) (UK)

25452 GENETIC EFFECTS OF GAMETOPHYTE IRRADIATION IN BARLEY. I. SEEDLING MUTANTS. Donini, B. (Centro Studi Nucleari della Casaccia, Rome); Devreux, M.; Scarascia-Mugnozza, G. T. Radiat. Bot.; 10: 79-86(Feb 1970).

Spikes of barley were acutely irradiated (1500 R, 93 R/hr) in a γ field (^{60}Co source) at different developmental stages of their gametophytes. M_1 plants were raised following irradiation of male gametopnytes, female gametophytes and both male and female gametophytes. A total of 2961 M_1 plant progenies were analyzed for chlorophyll and morphological mutation at the seedling stage; 6 to 12 spikes were scored for each M_1 plant. Analysis of the 94 segregating progenies showed the presence of mutation in all spikes of the M_1 plants; these, therefore, are to be considered heterozygous for the induced mutation. The deficit of recessives found in many of the segregating heterozygous progenies is discussed. The importance of haplophyte irradiation for mutation induction is emphasized; it overcomes, at least in a diploid species such as barley, the chimeric situation which occurs after treatment of multicellular structures (seeds or buds) or even of zygotes. (auth) (UK)

25453 DARK-RECOVERY PROCESSES IN ESCHERICHIA COLI IRRADIATED WITH ULTRAVIOLET LIGHT. III. EFFECT OF REC MUTATIONS ON RECOVERY OF EXCISION-DEFICIENT MUTANTS OF ESCHERICHIA COLI K-12. Ganesan, Ann K.; Smith, Kendric C. (Stanford Univ., Calif.). J. Bacteriol.; 102: 404-10(May 1970).

Mutants of Escherichia coli K-12 unable to excise pyrimidine dimers from their deoxyribonucleic acid (DNA) because of a uvr mutation show a higher survival when plated on a minimal salts medium after exposure to ultraviolet radiation that when plated on a complex medium such as nutrient agar containing yeast extract. This response has been called minimal medium recovery (MMR). Recovery of uvr mutants can take place in liquid as well as on solid medium, but not in buffer or under conditions of amino acid starvation that do not permit cell growth and normal DNA replication. MMR can thus be distinguished from the recovery of recombination-deficient (rec$^-$ uvr$^+$) derivatives of K-12 which can occur under conditions where growth is not possible. Because MMR is characteristic of excision-defective mutants, it evidently reflects a type of repair independent of excision. We have obtained genetic evidence that MMR is determined by the rec genes, which also control recombination in K-12. Cells carrying a uvr mutation together with recA13, recA56, recB21, or recC22 failed to show MMR and were more sensitive to ultraviolet radiation than either their rec$^+$ uvr$^-$ or rec$^-$ uvr$^+$ parents. The rec$^+$ uvr$^-$ derivatives obtained from recA uvr$^-$ strains by transduction or by reversion regained the capacity for MMR. Our results indicate that inactivation of any one of the three genes, recA, recB, or recC, prevents cells from showing MMR. (auth)

25454 PROPERTIES OF A DEOXYRIBONUCLEIC ACID LIGASE MUTANT OF ESCHERICHIA COLI: X-RAY SENSITIVITY. Dean, Cynthia; Pauling, Crellin (Univ. of California, Riverside). J. Bacteriol.; 102: 588-9(May 1970).

A deoxyribonucleic acid ligase-deficient mutant is x-ray sensitive relative to the parent strain, suggesting that deoxyribonucleic acid ligase functions in repair of x-ray-induced, single-strand scissions. (auth)

25455 INDUCTION OF MUTATIONS BY GAMMA RAYS AND DIETHYL SULFATE IN SPRING WHEAT. Woo, Shiu-Chu. Pullman, Wash.; Washington State Univ. (1969). 116p.
Thesis.

This investigation was designed to study the effects of γ radiation and diethyl sulfate (dES) and to compare the mutation patterns induced by these two mutagens in spring wheat. The variety Marfed C. I. 11919 was used as the biological material. Moisture controlled seeds were treated with a range of doses involving γ radiation or diethyl sulfate and with radiation plus diethyl sulfate. The time of presoaking seeds was varied in the dES treatments. Induced seedling injury and reduction in survival were measured on the M_1 generation and induced variations in culm length, resistance to strip rust, spike types, growth habit, awning, and male sterility were identified in the M_2 generation. M_1 seedling injury and reduction in survival generally increased exponentially with the increase of mutagen dose. The sensitivity of the seeds to dES increased with increased time of the presoak treatment. The additive γ ray + dES treatments were synergistic in their effects on both seedling injury and reduction in survival. In general, the additive mutagen treatments induced the highest gross mutation rate. The γ radiation treatments were next most effective and dES treatments least effective. Genetic analysis of some short-culm mutants induced in earlier experiments showed most mutants to be recessive. However, one of the ethyl methansulfonate (EMS) induced short-culm mutants was proved to show completely dominant single gene inheritance for culm shortening. A genetic analysis of stripe rust resistance, two crosses made between mutants from earlier experiments, showed two pairs of complementary genes in one and two pairs of recessive genes conditioning the rust resistance in the other. The small number of stripe rust resistant variants identified in the M_2 population from the various mutagen treatments were found to be heterozygous. Mutants of various spike types, including compactoids and speltoids, were more frequently found in the radiation treatment than in the dES treatment. Mutants with winter growth habit, awning, and male sterility were also recorded but their frequencies were relatively lower than the spike type variation. Chi-square test of independence indicated that association between the mutation of winter growth habit, semi-dwarf, and male sterility did not appear to be associated. (Diss. Abstr.)

25456 X-RAY INDUCED MUTATIONS IN DRY SPORES OF BACILLUS MEGATERIUM. Ewing, David Leon. Austin, Tex.; Univ. of Texas (1969). 83p.
Thesis.

The kinetics of mutation induction (to streptomycin resistance) were studied in dry spores. The spores, equilibrated for 1 hr at a water vapor pressure of 5×10^{-4} Torr, were irradiated (50 kvp x rays) in $\frac{1}{2}$ atmosphere of oxygen and held unopened for 24 hrs at 37°C. After irradiation, two dose-mutation responses were studied. One response was obtained when streptomycin was present in the growth medium at the beginning of incubation. Under these conditions, the number of induced mutants reached a maximum, then declined as the dose was increased. At this maximum, the number of induced mutants is about 12 times the spontaneous level. A second type of response was seen when the irradiated spores incubated on the growth medium for varying times before the addition of streptomycin. At a constant dose, the mutant yields fluctuated, passing through maximum and minimum levels, according to the radiation dose and the lengths of time on the growth medium before the addition of streptomycin. (Studies are underway to see if this fluctuating response can be related to biochemical events during spore germination.) If the maximum number of mutants at each dose is used in the dose-mutation analysis, another peaked response is obtained, although the peak occurs at a higher dose than for the first response above. The number of mutants at this peak is approximately 200 times the spontaneous level. The peak responses are not due to a selective killing of induced mutants at higher doses. Various other physical conditions are being tested in relation to this peaking phenomenon. (Disser. Abstr.)

25457 RUPTURE OF RADIATION-INDUCED ANAPHASE BRIDGES. Heddle, J. A.; Scott, D. (Univ. of California, San Francisco). Radiat. Bot.; 10: 11-17(Feb 1970).

As the frequency of radiation-induced dicentrics increases, the proportion that give rise to anaphase bridges decreases. Conger has shown that this decrease is not the result of a changing centromere segregation, but rather results from an increased frequency of ruptured bridges at larger radiation doses. He has suggested that rupture occurs at weak spots in the chromosomes where breaks have been repaired. At higher doses a bridge would contain more repaired breaks and so have a higher probability of rupture. If this were true, then the probability of rupture should be dependent only on total dose and not on dose rate since breaks are induced linearly with dose. In contrast, our data obtained at two dose rates show that the probability of rupture is not simply a function of the total dose, but is related more directly to the frequency of exchange. (auth) (UK)

25458 X-RAY MUTAGENESIS OF CULTURED CHINESE HAMSTER CELLS. Bridges, B. A.; Huckle, J.; Ashwood-Smith, M. J. (Medical Research Council, Harwell, Eng.). Nature (London); 226: 184-5(11 Apr 1970).

A mutation giving resistance to 8-azaguanine has been described for Chinese hamster cells. Such resistance is due to a recessive mutation resulting in the inactivation of the gene specifying inosinic and pyrophosphorylase, and this is presumably a forward mutation which may result from any of a large number of different changes at the gene concerned. The studies described show that the rate of indirection of such mutations in cultured Chinese hamster cells after x-irradiation is considerably greater than the rate found for comparable forward mutations in bacteria. Irradiation was with 250 kV3p x-rays to doses of 450 to 600 R. It was concluded that x-rays are definitely mutagenic in this system. The length of incubation is important; 10 days incubation was optimal. Comparisons are made with the behavior of E. coli, for which the mutation rates were two order of magnitude lower. One interpretation of the high radiation induced mutability of hamster cells could be that repair of DNA lesions is predominantly error-prone after x-irradiation. (UK)

25459 PROCEEDINGS OF INTERNATIONAL SEMINAR ON CHROMOSOME, ITS STRUCTURE AND FUNCTION, CALCUTTA, AUGUST 11-13, 1968. Sharma, Arun Kumar; Sharma, Archana (eds.). Nucleus (Calcutta), Supplementary Volume 1968. Calcutta; University of Calcutta (1968). 386p. $17.00. (CONF-680846).

Separate abstracts were prepared for eleven papers presented at the conference. An additional 24 papers were presented on various aspects of chromosome structure and function. (H.L.W.)

For abstracts of individual papers see: 25460–25469 and 25608.

25460 TOPOGRAPHIC ANALYSIS OF RESTING NUCLEUS BY MEANS OF IONIZING RADIATIONS AND CHEMICALS. Moutschen, J. (Univ., Liege). Nucleus (Calcutta), Suppl.; 1-12(1968).

From International Seminar on Chromosome, Its Structure and Function, Calcutta, India. See CONF-680846.

The analysis of some relationships of different regions of the nucleus was carried out in Nigelia damascena dormant seeds. Seed irradiations give rise to chromosome (G_1) aberrations. By analysis of dicentrics and rings, it was found that a larger proportion of aberrations is specifically localized in the end of chromosomic arms. From this observation the position of these chromosome segments could be inferred. The terminal location of the aberrations also appeared in other plant materials after treatment with several chemicals. Chemicals which show a selectivity in breaking heterochromatin could also be used to study the behavior of this component. This was especially studied with L-threitol-bis-methane sulfonate which induced a great amount of polycyclic aberrations in Vicia. Information on the behavior of nucleolar organising region and its relationship with other chromosome segments could also be obtained in Nigella by labeling differentially several chromosome regions and observing the sequence of aberrations for each chromosome. Cells with abnormal numbers of nucleolar organizers were induced by ionizing radiations and chemicals. These cells allowed to detect some relationships in space and time of different regions in the main nuclei. (auth)

25461 IRRADIATION STUDIES ON PTEROTHECA FALCONERI. NUMERICAL ALTERATION IN CHROMOSOME COMPLEMENT BY BREAKAGE. Mehra, P. N.; Singh, Paramjit (Punjab Univ., Chandigarh, India). Nucleus (Calcutta), Suppl.; 13-30(1968).

From International Seminar on Chromosome, Its Structure and Function, Calcutta, India. See CONF-680846.

Effects of exposure of Pterotheca falconeri seeds to different doses of x-rays were studied. The species possesses an asymmetrical karyotype of 3 pairs of individually recognisable chromosomes. Aberrant leaves were noticed in plants from seeds exposed to 15,070 R and above. No plant was found to survive at exposures of 60,000 R or above. Besides some other aberrations noticed at meiosis in the progeny of X_1 plants, an interesting individual appeared which showed 4 functional bivalents instead of the normal 3 at meiosis. It produced fertile pollen and viable seeds. Its origin is alluded to the fragmentation of A chromosome pair at the centromere region so that each arm of the chromosome possessed a part of the centromere enabling it to function normally. (auth)

25462 INCOMPLETENESS OF CHROMOSOME REJOINING AND SOME GENETICAL CONSEQUENCES. Moutschen-Dahmen, M. (Univ., Liege). Nucleus (Calcutta), Suppl.; 31-5(1968).

From International Seminar on Chromosome, Its Structure and Function, Calcutta, India. See CONF-680846.

On Nigella, the incompleteness of chromosome rejoining was measured for asymmetrical chromosome exchanges (ratio of incomplete interchanges and intrachanges to the total number of exchanges). It was investigated after treatments with ^{137}Cs γ rays, 2, 8 GeV protons, fission neutrons, monoenergetic neutrons from 0, 43 to 1, 8 MeV, thermal neutrons and α rays from two nuclear reactions: $^{10}B(n,\alpha)^{7}Li$ and $^{7}Li(n,\alpha)^{3}H$. In all cases investigated the proportion of incompleteness was found to be fairly constant. From these data a method was elaborated to estimate the amount of symmetrical exchanges, the majority of which escape observation after seed irradiation. A correlation between the amount of symmetrical interchanges calculated from seed irradiation data and the amount of translocations (rings of 4, etc) at meiosis could be established. The possibility of such correlation between symmetrical intrachanges and inversions at meiosis is discussed. (auth)

25463 ON THE MOLECULAR AND CHROMOSOMAL BASIS OF DOSAGE COMPENSATION IN DROSOPHILA. Mukherjee, A. S.; Lakhotia, S. C.; Chatterjee, S. (Univ. of Calcutta). Nucleus (Calcutta), Suppl.; 161-73(1968).

From International Seminar on Chromosome, Its Structure and Function, Calcutta, India. See CONF-680846.

In Drosophila the single X-chromosome in male salivary glands appears to compensate the dosage of sexlinked genes by an enlargement to nearly the size of, and performing as much transcriptive activity as, the paired X-chromosomes of the female. The pattern of RNA synthesis in the X-chromosomes is highly concordant in the two sexes, in both species, melanogaster and hydei, in spite of their having different X-chromosome constitution. X-irradiation (0.5 to 5 Kr) induces considerable reduction of the width of the male X, in a manner not conforming with an all-or-none mechanism (average ratio of width, - female's 2X: male's 1X = 1.10 in control, 1.23 to 1.35 in treated; significant at 1% level). The reduction is reversible and may involve the whole or a part of the X. Furthermore, a differential degree of puffing activity has not been observed in the X-chromosomes in the two sexes in D. hydei (except some minor plus or minus activity difference), under both normal and experimentally induced conditions. It appears that the modus operandi of dosage compensation underlie a repressible (as in females) or an inducible (as in males) control by one or more groups of localized regulatory loci, each of which may have an assignment on a specific set of genes (piecemeal device of Muller and Kaplan). Their controlling functions are realized at the chromosomal level only in the male, by a stepwise enlargement of the X and an enhanced rate of RNA synthesis. (auth)

25464 INDUCED X-CHROMOSOMAL ABERRATIONS IN THE STUDY OF INTRA- AND INTERSPECIFIC RADIOSENSITIVITY OF GRASSHOPPERS. Manna, G. K.; Mazumder, S. C. (Univ. of Kalyani, India). Nucleus (Calcutta), Suppl.; 197-207(1968).

From International Seminar on Chromosome, Its Structure and Function, Calcutta, India. See CONF-680846.

Males of eight species of grasshoppers - Tristria pulvinata, Phloeoba antennata, Acrida gigantea, A. lugula, Oxya velox, Spathosternum prasiniferum, Heteracris robusta and Orthacanthacris flavescens, were irradiated at a dose of 160 R with a Picker's x-ray machine operated at 110 KVP. The testes of the irradiated males fixed at 48 hour have been employed as the materials for study. The X-chromosome aberrations in the form of chromatid, chromosome and mixed type breaks at diplotene-diakinesis stages have been used as the indicator for testing the radiosensitivity at the intra- and inter-specific levels. The X-chromosomes of unirradiated males served as the control of each experiment. Intra-specific radiosensitivity has been tested in 21 individuals of P. antennata, in 12 individuals of A. gigantea and in 13 individuals of A. lugula. The individuals were irradiated in three lots for each species at different intervals of time. Different types of X-chromosome aberrations at diplotene-diakinesis stages were scored from a range of 10 to 160 cells from each individual and the data have been presented in detail. Percentage values of X chromosome aberrations in each individual of the three different species have been calculated. The results apparently indicated some differences at the intra-specific level but a statistical analysis revealed it to be insignificant which is applicable to each of the three species of grasshoppers. A discussion has been made to correlate the present result with some other published data on intra-specific radiosensitivity. Interspecific radiosensitivity in the eight species mentioned above has been tested. In T. pulvinata 1627 cells from 46 individuals, in P. antennata 1,740 cells from 39 individuals, in O. velox 3,498 cells from 19 individuals, 955 cells from 18 individuals of A. gigantea, 1,190 cells from 27 individuals of A. lugula, 1,183 cells from 28 individuals of S. prasiniferum, 1,536 cells from 10 individuals in H. robusta and 1,414 cells from 3 individuals of O. flavescens have been tested for the study of interspecific radiosensitivity of the X-chromosome. Assuming different mechanisms of the production of aberration, three types of testing have been made for determining the sensitivity. A differential response of the X-chromosomes has been exhibited by the different species. Further, the result indicated that the X-chromosome volume has no direct relationship with the amount of radiation damage. Analysis of the data of different species indicated that there exists definite interspecific radiosensitivity and the species have been grouped according to their relative radiosensitivity. (auth)

25465 CYTOGENETIC EFFECTS OF X-RAYS AND COLCHICINE ON TOMATO LYCOPERSICON ESCULENTUM MILL. STUDIES IN THE M_2 GENERATION. Bose, S.; Banerjee, B. (Univ. of Calcutta). Nucleus (Calcutta), Suppl.; 208-12(1968).

From International Seminar on Chromosome, Its Structure and Function, Calcutta, India. See CONF-680846.

Cytogenetic investigations undertaken in the M_2 generation plants originating from colchicine (0.2%) treatment and those from 10 kr + colchicine (0.2%), 20 kr + colchicine (0.2%) and in the hybrids originating from control × control, colchicine (0.2%) × control, 10 kr + colchicine (0.2%) × control and the reciprocal and 20 kr + colchicine (0.2%) × control showed the frequency and types of meiotic aberrations to be more in the hybrids than in those originating after post-irradiation-treatment with colchicine (0.2%). Meiotic irregularities were still fewer in those originating after colchicine (0.2%) treatment alone. Morphological abnormalities, pollen sterility, fruit and seed set also more or less followed the same pattern. An interesting observation was the finding of stomata with one or no guard cells. (auth)

25466 BASIC PROTEIN AND CHROMOSOME BREAKAGE. Sen, Sumitra (Univ. of Calcutta). Nucleus (Calcutta), Suppl.; 213-16(1968).

From International Seminar on Chromosome, Its Structure and Function, Calcutta, India. See CONF-680846.

Roots of Allium cepa and A. sativum were treated with solutions of DNAase, RNAase, pepsin, and trypsin. They were then uv-irradiated and observations were made at 24 hr intervals up to 120 hrs. It was found that chromosome breakage occurred in the absence but not in the presence of basic protein. It was concluded that basic protein or histone acts as a repressor for repair complexes or some uv affected basic protein intermediate complex is formed that checks chromosome breakage. (H.L.W.)

25467 STUDIES ON CARROT CALLUS TISSUE. Roy, Satyesh Chandra (Univ. of Calcutta). Nucleus (Calcutta), Suppl.; 223-4(1968).

From International Seminar on Chromosome, Its Structure and Function, Calcutta, India. See CONF-680846.

Artificial cultures of carrot pith were prepared for studies on root formation. Cultures were irradiated with 5,000 and 10,000 R doses of x rays, and after one month chromatid bridges and other types of chromosome aberrations were observed. (H.L.W.)

25468 CHROMOSOMAL CHANGES IN A MALIGNANT CELL POPULATION DUE TO ALTERATION OF ENVIRONMENT. Purkayastha, Chitra (Presidency Coll., Calcutta). Nucleus (Calcutta), Suppl.; 336-8(1968).

From International Seminar on Chromosome, Its Structure and Function, Calcutta, India. See CONF-680846.

Following successive transplants of ascites tumors, mice were given 300 R whole-body x radiation. Further transplants were made into non-tumor-bearing hosts that were given 300 to 24,150 R x radiation. Controls consisted of unirradiated serial transplants. Cytological studies revealed that the stemline in controls remained stable consisting of 69 chromosomes. Many chromosome aberrations were observed in the tumor samples. After 35 passages of irradiated cells the chromosome number of 63 began to appear; this stem line remained stable after cells were removed from the source of x rays. The irradiated tumor was of interest in that its growth was apparently slower than the non-irradiated tumor line and in that it showed a higher degree of radioresistance. The two lines did not differ in strain specificity. (H.L.W.)

25469 INVESTIGATIONS ON THE GENETIC CONTROL OF MEIOSIS. Gottschalk, W. (Univ., Bonn). Nucleus (Calcutta), Suppl.; 345-60(1968).

From International Seminar on Chromosome, Its Structure and Function, Calcutta, India. See CONF-680846.

Groups of desynaptic, asynaptic and male-sterile x-ray induced mutants of Pisum sativum were cytogenetically studied. The following results were obtained: Meiosis of 16 desynaptic mutants showing a continuously increasing reduction of chiasma frequency was analyzed. Most of these mutants are completely sterile because of the large number of univalents and there is a direct correlation between the frequency of univalents, the frequency of irregularities in later meiotic stages and the proportion of functioning germ cells. The influence of genes on macrosporogenesis is less intensive than on microsporogenesis. It could be shown by hybridizations between some fertile mutants of this group that the genes in question do not belong to a multiple series. Three asynaptic mutants were found in this collection showing no pairing of homologous chromosomes and being likewise completely sterile. Ten mutants showed a breakdown of microsporogenesis and a degeneration of PMCs in different but specific meiotic stages while no corresponding behavior could be observed in macrosporogenesis. Some of these mutants are characterized by specific additional meiotic anomalies indicating that these male-sterile genotypes cannot be regarded to represent a homogeneous group. All mutants studied are caused by the action of single recessive genes. In this way, it is possible to get an insight in the mechanism of the genetic control of meiosis. (auth)

Health Physics and Safety

Refer also to abstract 25527.

25470 BASIC RADIATION PROTECTION. PRINCIPLES AND ORGANIZATION. Easley, C. W. New York; Gordon and Breach Science Publishers Inc. (1969). 137p. $12.50.

The ten chapters and their major divisions are as follows: Introduction to Radiation (atomic structure, radioactivity, transmutation, artificial radioactivity, medical and industrial applications, maximum permissible radiation exposures); Basic Principles of Radiation and Detection (gas ionization instruments, photographic emulsions, scintillation detectors, chemical decomposition indicators, radiophotoluminescence, indication devices); monitoring instruments (instruments, survey instruments, photodosimetry); Permissible Doses, Levels, and Concentrations (biological effects and modifying factors, maximum permissible dose determination); Permissible Contamination Levels and Contamination Control (laboratory design and contamination control, permissible contamination levels); Spills and Decontamination Monitoring (prevention, types of contamination, materials contaminated, decontamination, principles of protection, water contamination, monitor's check list); Air Sampling and Sealed Source Leak Testing (atmospheric contaminants, particle size, methods, general air sample versus breathing zone sample, types and calibration of air samplers, counting and calculation, characteristics of filter papers); X Rays (x-ray tube, x-ray circuits, production of x rays, absorption of x rays by matter); Neutrons (properties, radiation protection, shipping precautions); Waste Disposal (criteria, methods, procedure for radioactive wastes in laboratories). Two appendixes provide definitions and glossary of terms and samples of record-keeping forms. A brief index is provided. (C.O.)

Radioactive Contamination and Decontamination

Refer also to abstracts 25127, 25143, 25164, 25251, 25252, 25421–25425, 25430, 25431, 25434–25438, and 25558.

25471 (A-AC-82/G/L-1294) THE DYNAMICS OF FISSION-PRODUCT ACCUMULATION IN VEGETABLES. Perova, A. A.; Prokof'ev, O. N.; Shvydko, [illegible] S.; Dikaya, E. Ya.; Vyalushkina, N. I. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). 1969. 9p. (In Russian). Dep. CFSTI (U. S. Sales Only).

A total of 1052 samples of potatoes, carrots and cabbages from 45 control points in different geographical regions of the country were analyzed for strontium-90, cesium-137, calcium and potassium over the time period from 1962 to 1967. The activity was the lowest in potatoes with a content of 2 to 14 picocuries (pc) of strontium-90 per kg of weight, and a content of 5 to 65 picocuries/kg for cesium-137. The maximum concentrations of strontium-90 were 14 to 84 pc/kg in carrots and 20 to 98 pc/kg in cabbage, while the cesium-137 activities were 58 to 95 pc/kg in carrots, and 60 to 250 pc/kg in cabbage. The average strontium-90 concentrations were at a level of 11 to 14 pc/kg in carrot, and 11 to 34 pc/kg in cabbage, while the average cesium-137 concentrations were 15 to 60 pc/kg in carrots and 18 to 60 pc/kg in cabbage. The concentration of strontium-90 is determined primarily by the cumulative fallout, while the cesium-137 concentration is determined by the rate of the global fallout. The concentrations ratios of strontium-90 and cesium-137 in cabbage changed to reflect the decrease in global fallout over this period. (TTT)

25472 (A-AC-82/G/L-1297) THE CONCENTRATION OF ^{90}Sr IN FOODSTUFFS AND ITS DIETARY INTAKE AMONG THE POPULATION OF THE ARMENIAN SSR DURING THE PERIOD 1963–1967. Atanesyan, S. G.; Arevshatyan, R. A.; Karapetyan, Sh. V.; Shokoreva, S. I. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). 1968. 15p. (In Russian). Dep. CFSTI (U. S. Sales Only).

More than 500 radiochemical analyses for ^{90}Sr were carried out. High concentrations of ^{90}Sr were observed in bread, milk, cheese, spinach, grape leaves, greens and fish. The ^{90}Sr content was higher by a factor of two in foodstuffs from the hills than from the plains. The greatest concentration of ^{90}Sr was noted in 1963 to 1964, which is connected with the greater fallout of ^{90}Sr in 1962 to 1963. The ^{90}Sr concentration fell by a factor of three or more in 1965 to 1967. The ^{90}Sr uptake from the daily diet was estimated, and it was found that the main sources of supply from the diet were bread (55%), milk products (28%) and vegetables (10%). The Armenian population received 2 to 4 times as much ^{90}Sr as the rest of the population in Russia as a whole. (TTT)

25473 (DPST-70-30-1) EFFECT OF THE SAVANNAH RIVER PLANT ON ENVIRONMENTAL RADIOACTIVITY. Semi-annual Report, July–December 1969. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Apr 1970. Contract AT(07-2)-1. 19p. Dep. CFSTI.

Results of the environmental monitoring program for the atmosphere, vegetation and food, milk, and water are presented. The quantity of radioactive waste released by the Savannah River Plant to its environs was, for the most part, too small to be distinguished from natural background radiation or was obscured by fallout from offsite sources. Beta activity in air, which showed no relationship with plant operations, was about the same as that observed for the previous six-month period and was twofold higher than the same period of 1968. Radioactive materials in fish flesh continued to be far below levels considered significant from a health standpoint. The average concentration of any radionuclide in river water at Highway 301 did not exceed 0.4% of the concentration guide. (auth)

25474 EVALUATION OF VEGETABLE FOODS AFTER TREATMENT FOR RADIOACTIVE DECONTAMINATION. Paulus, K. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.). Z. Lebensm.-Untersuch. Forsch.; 142: No. 1, 17-24(1970). (In German).

The suitability of fruits and vegetables for human nutrition following treatment for radioactive decontamination was investigated. Chemical analyses indicated that the nutritive value was impaired as a result of leaching and the influence of heat, and was therefore lower than that of normally prepared products. The organoleptic properties of the products were affected only slightly by the decontamination treatment. Sensory evaluations showed that the more sensitive products, such as spinach, were impaired in this respect whereas some of the other products, such as potatoes, exhibited an enhancement of their organoleptic properties. (E.R.B.)

25475 MICROWAVE POWER ENGINEERING. VOLUME 2. APPLICATIONS. Okress, Ernest C. (ed.). Electrical Science. A Series of Monographs and Texts. New York; Academic Press Inc. (1968). 430p. $17.00.

Separate abstracts were prepared on nine sections of this book. Other sections discuss other new applications of microwave power including: food heating, thawing, freeze drying, and the processing of potato chips and other dry foods; the processing of concrete and timber; sealing of plastics; applications for aerospace and military purposes; the development of microwave motors; and the development of microwave guides for vehicle transport systems. (C.H.)

For abstracts of individual papers see: 25625–25628, 25352, 25586, 26146, 26169, and 26566.

25476 DETERMINATION OF ^{90}Sr AND ^{137}Cs IN FOOD RATION BY THEIR CONTENT IN MILK AND BREAD. Shvydko, N. S.; Prokofev, O. N. Gig. Sanit.; No. 11, 45-8(Nov 1969). (In Russian).

Data on the presence of a definite correlation between concentration of ^{90}Sr and ^{137}Cs in milk and bread and that of their level in the food ration for children and adult population of the Russian Soviet Federative Socialist Republic are presented. The data obtained make it possible to simplify the method of determining the level of isotopes in the food consumed by the population. (auth)

Dosimetry and Monitoring

Refer also to abstracts 25142, 25144, 25256, 25262, 25269, 25286, 25304, 25306, 25312, 25328, 25363, 25426, 25449, and 25498.

25477 (BNWL-1221, pp 7.1-25) IN VIVO COUNTING OF PLUTONIUM IN DOGS. Park, J. F.; Roesch, W. C.; Swinth, K. L.; Watson, C. R.; Willard, D. H.; Bair, W. J. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

The use of in vivo counting for the measurement of ^{238}Pu, ^{239}Pu, ^{240}Pu, and ^{241}Am in experimental dogs has proved feasible. A number of factors have been identified which constitute potential problems to correct interpretation of the data. Among these are isotopic composition of the Pu, distribution of Pu within the animal, separation of Pu from Am in the case of inhaled $Pu(NO_3)_4$, and external contamination of the animal. (auth)

25478 (BNWL-1340) AEC WORKSHOP ON PERSONNEL NEUTRON DOSIMETRY, SEPTEMBER 23–24, 1969, BETHESDA, MARYLAND. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). [1970]. Contract AT(45-1)-1830. 67p. Dep. CFSTI.

The current state of personnel neutron dosimetry is reviewed and current developmental programs are discussed. Since there is no personnel neutron monitoring system for all neutron energies, several techniques were developed for evaluating personnel neutron dose equivalent by various monitoring groups. The most commonly used methods include: Utilization of a gamma to neutron dose rate ratio technique to estimate neutron dose equivalent. The use of a laboratory rem dose meter coupled with workmen time studies to estimate neutron dose. Use of the Bendix type pocket neutron dosimeters to measure neutron dose equivalent rates. Application of an adequate safety factor in the establishment of annual dose limits to allow for possible neutron exposures. The use of two films and specially designed personnel dosimeters for measuring thermal and fast neutron dose. The measurement of thermal neutron dose equivalent; where the ratio of thermal to fast neutron dose equivalent remains constant, a correction factor may be applied to the thermal neutron dose equivalent measurement to obtain the total neutron dose equivalent. The use of NTA film calibrated with the neutron source to which it will be exposed for estimating total neutron dose equivalent. All of these techniques are useful in a given situation but none of them meet the requirements of being a good personnel neutron monitoring system for all neutron energies under all neutron exposure conditions. Most fast neutron dosimetry programs have utilized nuclear track counting techniques with NTA films. The current personnel neutron monitoring situation may be summarized as follows. There are several acceptable thermal neutron monitoring dosimeters available and in general use. Under proper conditions the NTA film can provide reliable and satisfactory fast neutron dose equivalent monitoring. Several laboratories are using NTA film to good advantage for fast neutron dosimetry. For the intermediate energy neutron exposure around reactor facilities and for moderated fast neutron sources NTA personnel neutron dosimeters cannot be effectively used. This leaves a major gap in the personnel dosimetry program that at many installations may be quite serious. New approaches, methods, and equipment to improve monitoring for intermediate energy neutrons are needed and constitute the bulk of the discussion in this report. Several approaches utilizing albedo neutrons are being developed and seem to be the most promising for monitoring intermediate neutrons. These include neutron detector elements of ^{6}Li and ^{7}Li in various geometries of thermal neutron shielding and the application of techniques of thermally stimulated exoelectron emission. (E.R.B.)

25479 (CEA-CONF-1445) EFFECTIVE PERIOD OF ^{7}Be IN VIEW OF THE BIOLOGICAL DOSIMETRY OF PROTONS OF HIGH ENERGY. Legeay, G.; Tardy-Joubert, Ph.; Guenet, J. L.; Jaureguy, J. C. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). [1969]. 6p. (In French). Dep. CFSTI (U. S. Sales Only).

Experimental results show that the elimination of ^{7}Be formed by spallation in the intra- and extracellular spaces is more rapid than that of doses injected in the rat at rates near to the maximum permissible quantity, fixed at 600 μCi for the whole organism in the standard man. It is necessary to multiply the effective period found in this last case by 0.7 in order to obtain the former. If this fact is related to man in the case of a proton irradiation where the quantity of ^{7}Be formed would be very low, the effective period to be applied would be 30 days instead of 41 days, the value indicated by the ICRP. This correction is important for the determination of the initial activity because the measurement on the individual does not always occur immediately. This would permit a more precise determination of the dose absorbed by the organism. (tr-auth)

25480 (FOA-4-4418) BETA- AND GAMMA-DOSE MEASUREMENTS IN THE GASTROINTESTINAL TRACT OF GOATS WITH LiF DOSIMETERS AFTER A SINGLE INTAKE OF SIMULANT MIXED FISSION PRODUCTS. Ekman, L.; Funkqvist, B. (Kungliga Veterinarhogskolan, Stockholm (Sweden)); Greitz, U. (Forsvarets Forskningsanstalt, Stockholm (Sweden)). Mar 1970. 20p. Dep. CFSTI (U. S. Sales Only).

The gamma- and beta-dose distribution in the gastrointestinal tract of goats was investigated following oral administration of a mixture of samarium-153 and lanthanum-140 which simulates mixed fission products. LiF teflon rod dosimeters were used to measure the gamma- and beta-doses delivered to the intestinal walls. The size of the rods (1 × 6 mm) permitted surgical placement close to the walls inside the intestines for registration of beta- and gamma-doses. For registration of the gamma doses lucite shielded dosimeters were used placed outside of the walls. Calibration experiments were performed simultaneously with the in vivo experiments with the aim to estimate the beta dose delivered to the intestinal walls. It was found that the terminal colon and cecum got the highest doses. It was estimated that these organs received a beta dose of 3 rads and a gamma dose of about 2 rads per mCi ^{153}Sm and ^{140}La in the activity proportions 1.6/1. (auth)

25481 (HASL–224) FALLOUT PROGRAM. Quarterly Summary Report, December 1, 1969–March 1, 1970. Hardy, Edward P. Jr. (New York Operations Office (AEC), N. Y. Health and Safety Lab.). 1 Apr 1970. 156p. Dep. CFSTI.

Current data from the HASL Fallout program, the National Radiation Laboratory in New Zealand, the EURATOM Joint Nuclear Research Centre, and the Radiological Physics Division at Argonne National Laboratory are presented. Interpretive reports and notes are also included covering the following topics: radium-226 in diet in United States, plutonium-239 anomaly in the troposphere, and the quality of radiochemical analyses in the HASL surface air sampling program. A bibliography is presented of recent publications related to radionuclide studies. (E.R.B.)

25482 (HASL–224(App.)) FALLOUT PROGRAM. Quarterly Summary Report, December 1, 1969–March 1, 1970. Appendix. (New York Operations Office (AEC), N. Y. Health and Safety Lab.). 1 Apr 1970. 400p. Dep. CFSTI.

This appendix to the quarterly HASL fallout program report contains data on the following activities: ^{89}Sr and ^{90}Sr in monthly deposition at world land sites, radiostrontium deposition at Atlantic Ocean weather stations, plutonium isotopes at selected sites, radionuclides in surface air, and radiostrontium in milk and tap water. All data are presented in tabular form. A table of conversion factors used in the calculations and a radionuclide data table are also included. (E.R.B.)

25483 (JAERI–5024) HEALTH PHYSICS AND SAFETY AT OARAI RESEARCH ESTABLISHMENT (APRIL 1968–MARCH 1969). (Japan Atomic Energy Research Inst., Oarai. Oarai Research Establishment). Aug 1969. 52p. (In Japanese and English). Dep. CFSTI (U. S. Sales Only).

The activities of the Section of Health Physics and Safety, Oarai Research Establishment, JAERI are described for the period from April 1968 to March 1969. The contents consist of safety countermeasures, area monitoring of the JMTR and Radioisotope Laboratory, environmental monitoring of Oarai site, radioactive waste treatment and decontamination, radiation monitoring, and operational safety techniques. (auth)

25484 (LFEN–98-a) DOSES OF EXTERNAL RADIATION RECEIVED BY PROFESSIONAL PEOPLE EXPOSED IN X RAY AND RADIOISOTOPE INSTALLATIONS FOR MEDICAL PURPOSES. Carreiro, J. Vaz; da Silva, Heitor P. (Junta de Energia Nuclear, Sacavem (Portugal). Laboratorio de Fisica e Engenharia Nucleares). 1969. 19p. (In Portuguese). (CONF-680665–1). Dep. CFSTI (U. S. Sales Only).

From 11th Portuguese–Brazilian Radiological Conference, Lisbon, Portugal.

The results of the dosimetry of personnel during the two years from 1964 to 1967 in medical x-ray and radioisotope installations are analyzed. The distribution of doses accumulated per dose intervals, and the average annual dose per person in various types of installations were studied by analyzing in detail the elements relative to 1967 to determine installations judged to have a high mobility with the purpose of inferring the incidence of very high accumulated doses in given groups of duty functions in the professional people exposed. The radiation doses received in personnel with the maximum permissible dose were compared in order to determine the frequency with which these limits were exceeded. (tr-auth)

25485 (ORNL-TM–2924) THE ABSORBED DOSE AND DOSE EQUIVALENT FROM NEUTRONS IN THE ENERGY RANGE 60 TO 3000 MeV AND PROTONS IN THE ENERGY RANGE 400 TO 3000 MeV. Alsmiller, R. G. Jr.; Armstrong, T. W.; Coleman, W. A. (Oak Ridge National Lab., Tenn.). 20 Mar 1970. 63p. Dep. CFSTI.

Nucleon-meson cascade calculations have been carried out for monoenergetic neutrons (60 to 3000 MeV) and protons (400 to 3000 MeV) normally incident on a semi-infinite slab of tissue 30-cm thick, and the absorbed dose and dose equivalent as a function of depth in the tissue are presented. The calculated absorbed doses from 180- and 525-MeV incident neutrons and 660- and 730-MeV protons are compared with experimental data. For 525-MeV incident neutrons, the experimental and calculated absorbed doses are in good agreement; but this is not the case with the other comparisons. (auth)

25486 (SWRHL–47-r) OFF-SITE SURVEILLANCE ACTIVITIES OF THE SOUTHWESTERN RADIOLOGICAL HEALTH LABORATORY FROM JANUARY THROUGH JUNE 1967. (Public Health Service, Las Vegas, Nev. Southwestern Radiological Health Lab.). Mar 1970. 121p. Dep. CFSTI.

The Southwestern Radiological Health Laboratory of the Public Health Service performed off-site radiological surveillance for 16 announced events and one reactor experiment during January through June 1967. This surveillance was conducted in the public areas surrounding the Nevada Test Site under a Memorandum of Understanding with the U. S. Atomic Commission. During the six-month period, two announced nuclear events and two Experimental Plans of the Phoebus 1B reactor test series released radioactivity that was detected off-site. Analysis of all sampling and surveillance information compiled during the six-month period indicated that the safety criteria established by the Atomic Energy Commission for the off-site population were not exceeded. (auth)

25487 (UCRL–19376) A METHOD FOR MAPPING THE SPATIAL DISTRIBUTION OF STOPPING π^- MESONS IN TISSUE. Miller, A. J.; Raju, M. R.; Rindi, A.; Perez-Mendez, V.; Sperinde, J. (California Univ., Berkeley. Lawrence Radiation Lab.). 30 Oct 1969. Contract W-7405-eng-48. 6p. (CONF-691019–2). Dep. CFSTI.

From Meeting on Nuclear Physics Division, American Physical Society, Boulder, Colo.

The use of capture gamma rays from meson (π^-) stopping in tissue is described for the purpose of mapping the stopping region. Gamma rays of energy greater than 15 MeV were detected, and the measured distributions are shown. (J.F.P.)

25488 SUBSTANTIATION OF THE CHOICE OF DOSIMETRIC AND RADIOMETRIC EQUIPMENT USED IN SANITARY HYGIENIC INVESTIGATIONS. Lyarskii, P. P.; Korenkov, I. P.; Moiseitsev, P. I. Gig. Sanit.; No. 11, 74-81(Nov 1969). (In Russian).

Tabulated data and analyses are given for selection of applicable dosimetry recording devices for personnel and environmental control around various installations emitting radiations. (R.V.J.)

25489 RADIATION AND HYGIENIC FEATURES OF SOVIET-MADE TELEVISION SETS. Nevstrueva, M. A.; Liberman, A. N.; Bronshtein, I. E.; Nekrasova, N. A.; Safronova, M. V.; Yakimova, T. M.; Pekelnyi, A. I. Gig. Sanit.; No. 11, 39-44(Nov 1969). (In Russian).

Data from dosimetric investigation of black-white and colored Soviet-made television sets are presented. The maximum permissible intensity of roentgen radiation of the television sets was substantiated and a genetically significant dose of irradiation of the population was assessed. (auth)

25490 CONSIDERATIONS ON THE PROFESSIONAL EXPOSURES TO X-RAYS AND GAMMA RAYS FOR EXTENSIVE APPLICATIONS BASED ON PERSONNEL FILM DOSIMETERS. Susanna, A. (CNEN, Rome); Venier, A. G. Fis. Sanit. Prot. Radiaz.; 12: 98-103(1968). (In Italian). (RT/PROT–(69)35).

The results obtained from dosimetric evaluations effected within an extensive materials service for supervision of exposure to x and γ rays by means of sensitive-film dosimeters are presented. on 560,000 evaluations. The frequencies of several dose intervals are presented, as observed on badges on exposed persons, so the dose interval versus the highest number of exposed persons is identified. An analysis carried out in relation to working places (such as hospital and industries) reveals a different trend in the frequencies. The percentage of films showing lower doses than certain values increased with time. Also the lowering of over exposures (doses >3 R/month; doses >5 R/month) was noted during 1958 to 1966. Such observations show improvements in working conditions, probably caused by the increasing use of individual dosimeters. The results presented are briefly discussed. (auth)

25491 BIOLOGICAL DOSIMETRY. Brown, J. K.; Davy, D. R.; McNeill, J. R.; O'Brien, B. (Australian Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Australas. Bull. Med. Phys. Biophys.; No. 42, 16-20 (1 Dec 1969). (CONF-690830–1).

From Ninth Annual Meeting of Physics in Medicine and Biology, Perth, Australia.

The principle of utilizing chromosome aberrations in peripheral blood samples as a biological dosimeter is described. A case is described of two men accidentally exposed to a 22 curie ^{192}Ir source. Biological dosimetry indicated a whole body dose of 25 rem compared to a film badge estimate of 22 rem for one radiographer. (Australia)

25492 MEDICAL USES OF RADIOACTIVE ISOTOPES AND THE CONSEQUENT RADIATION EXPOSURE. Anno, Yasuo (Tottori Univ., Japan). Teishin Igaku; 21: 647-52(Aug 1969). (In Japanese).

The results of the surveys on the uses of radioisotopes in diagnosis and treatment and the subsequent effects of radiation are reported. Total number of cases in which RI was administered in 1968 was 142,954 of which 96.4% was in diagnosis. The most frequently used RI was ^{131}I; 40.2% in diagnosis and 3.0% in therapy, the total being 70% including 27.1% of various ^{131}I compounds for labeling. The total amount of RI administered reached 137,775 mCi, ^{131}I being 30.1%. A study of the thyroid function tests with ^{131}I indicated that the uptake by the thyroid gland averaged 84 rad. No specific relation was found between the incidence of malignant tumors and the ^{131}I therapy of hyperthyroidism. The national hereditary doses of ^{131}I were 0.03 mrad in hyperthyroidism therapy and 0.02 to 0.03 mrad in diagnosis. No significant change was observed in the sex ratio of newborn infants of ^{131}I-treated hyperthyroidism patients. The effects of exposure to radiation can be minimized by the use of RI with low radioactivity; the improvement of instruments and equipment, and sufficient knowledge of RI and careful monitoring. (NSA of Japan)

Radiation Protection

Refer also to abstracts 25281 and 25510.

25493 (CEA-CONF-1443) PROTECTION AGAINST IONIZING RADIATION: FORMATION AND INFORMATION OF PERSONNEL OF FRENCH NUCLEAR ESTABLISHMENTS. Bresson, Gilbert (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). [nd]. 10p. (In French). (CONF-690635-1). Dep. CFSTI (U. S. Sales Only).

From International Occupational Safety and Health Congress, Geneva, Switzerland.

In the prevention of radiation accidents, the first form of prevention is in the hands of the worker himself, the second is in the hands of the hierarchy, and the third is in the action of specialists. The basic need in each of these areas is information to the persons affected. The efforts made at French nuclear establishments to protect the personnel against ionizing radiation are summarized on these bases. (J.S.R.)

25494 (NCRP-34) MEDICAL X-RAY AND GAMMA-RAY PROTECTION FOR ENERGIES UP TO 10 MeV. STRUCTURAL SHIELDING DESIGN AND EVALUATION. Recommendations of the National Council on Radiation Protection and Measurements. (National Council on Radiation Protection and Measurements, Washington, D. C.). 2 Mar 1970. 117p. NCRP Publication, Washington, D. C. $1.50.

Design and operation of both x-ray and ^{137}Cs and ^{60}Co γ-source equipment for medical application are discussed. Shielding arrangements are evaluated as to material, joints, access to radiation room, and observation windows. General principles for the outlay of diagnostic as well as therapeutic installations are presented. General rules for supervising construction and for calibrating radiation doses are described. Facts and recommendations are compiled in 29 tables and 16 figures. Specifications concerning architecture and equipment from the standpoint of shielding are listed. (H.B.G.)

25495 (NCRP-35) DENTAL X-RAY PROTECTION. Recommendations of the National Council on Radiation Protection and Measurements. (National Council on Radiation Protection and Measurements, Washington, D. C.). 9 Mar 1970. 50p. NCRP Publications, Washington, D. C. $1.50.

Design and operation of dental x-ray equipment is discussed as well as problems related to structural shielding. Principles for determining the use of concrete or lead for barrier material and arrangements are outlined and presented in sketches and tables. Operationally, position of the dentist, holding of the tube housing, patient exposure, and film processing are analyzed. Recommendations and findings of surveys are presented in nine tables and six figures. (H.B.G.)

25496 (NP-18142) RADIATION SOURCES IN SECONDARY SCHOOLS. Report of a Limited Survey. (Bureau of Radiological Health, Rockville, Md.). Aug 1969. 65p. (ORO-69-5). CFSTI.

In accordance with the Radiation Control for Health and Safety Act, the Bureau of Radiological Health conducted a joint State-Federal survey in a nationwide selection of schools to assess the type, quantity, and use of potential or actual radiation emitting sources in science classrooms. As a result of the survey it was evident that a significant number of radiation sources were available which could pose a potential exposure problem to teachers and students. Examples of ionizing sources included x-ray and gaseous discharge tubes and radioactive materials. Non-ionizing sources included laser and microwave devices and ultraviolet lights. Recommendations discussed include establishing performance standards for radiation producing equipment and for equipment emitting radiation incidental to its intended use and laboratory testing of selected equipment on a continuing basis to assess potential radiation hazards. Tables include number of x-ray tubes in secondary schools, measured exposure rates from unshielded x-ray tubes in secondary schools, measured exposure rates from gaseous discharge tubes used to demonstrate heating effects in secondary schools, number and type of high voltage generators in secondary schools, and number and type of radioisotopes in secondary schools. (H.L.W.)

Safety Procedures

Refer also to abstracts 25369, 25439, and 25581.

25497 (UCRL-50789) ADVANCED RADIATION SAFETY TRAINING COURSE FOR MONITORS. Eger, Kenneth J.; Kase, Kenneth R.; Rich, Bryce L. (California Univ., Livermore. Lawrence Radiation Lab.). 12 Dec 1969. 43p. Dep. CFSTI.

The development of a self-study Advanced Radiation Safety Course for Monitors of the Hazards Control Department at the Lawrence Radiation Laboratory is described in the first part of this report. The purpose of the course is to provide standardized and effective continued education for safety technicians in preparation for increased responsibilities and promotion. An outline of the course divided into 12 sections is included. Each section contains a study guide, bibliography, and question set that cover the subject matter of the section. Knowledge of calculus by the student is not required. (auth)

25498 RADIATION LOADS OF PERSONNEL OPERATING THE LUCH-1 GAMMA-RAY MACHINE AND PREVENTIVE MEASURES. Kazhlaeva, U. I.; Samsonova, Z. A. (Azerbaydzhan Research Inst. of Roentgenology, Radiology, and Oncology, Baku). Azerb. Med. Zh.; No. 9, 55-8(1969). (In Russian).

The LUCH-1 apparatus used in the Azerbaydzhan Institute of Roentgenology, Radiology, and Oncology consists of a radiation head, stand, and control panel. The apparatus is situated in a specially designed room where it is surrounded on three sides by a protective wall. The spatial distribution of the radiation is determined from an isodose chart of the room. The radiation dose 0.25 m from the bomb constitutes 25% of the dose on the surface of the radiation head but only 10% at a distance of 0.80 m. Shielding devices ensure that technicians near the apparatus and behind the control panel do not receive more than 20 mr of radiation a week (5 times less than the maximum permissible dose) at the chest level and half that at the pelvic level. (JPRS)

25499 BIOLOGICAL ASPECTS OF LASER RADIATION. A REVIEW OF HAZARDS. Moore, Wellington Jr. Rockville, Md.; Bureau of Radiological Health (1969). 17p.

Concern over the hazards of exposure to laser radiation resulted in the establishment of guidelines for human exposure by several agencies. Owing to the incompleteness of knowledge concerning biological effects, particularly long-term ones, it is not possible to set firm protection standards at this time. Current guides are based upon the minimum dose required to produce a visible lesion. These threshold values may vary depending upon the criteria by which they are measured. For the eye, threshold damage has been determined by such varying means as ophthalmoscopy, light microscopic histology, histochemical study, and electroretinography. In histochemical studies, impairment of enzyme activity was apparent when the energy level of the light beam had been reduced by 10 to 15% below threshold for ophthalmoscopically visible or histologically detectable lesions. This raises the question of how damage in the human might be demonstrated below levels that are clinically apparent. Very little is known about the potential cumulative effects produced by repeated subthreshold exposures either to the eye or skin. Current data in this area are not sufficient to provide information concerning the possibility of cumulative effects from repeated exposures. There appears to be some conflict over the significance of repeated subthreshold exposures in the production of damage. Occupational hazards incidental to the use of lasers must be reduced to the very minimum. In addition to beam exposure, other potential hazards include contact with liquid nitrogen or other substances such as coolants, electrical shock, exposures to gases such as ozone, and explosions at capacitor banks, optical pump systems, and target area. A complete safety program is necessary to protect the operating personnel and other persons present at laser installations. (auth)

Civil Defense

25500 NUCLEAR DISASTER DRILL TESTS COMMUNITY STAMINA. Curry, Wesley. Hospitals; 43: 54-8(16 Aug 1969).

The role of a hospital in community needs and its adaptation to possible nuclear disaster are discussed. Experience in disaster drills at Little Company of Mary Hospital, Evergreen Park, Illinois, as part of its function as an official fallout shelter is reported. Such drills are conducted twice each year. The elaborate and methodical planning is outlined, Drill instruction is given in a classroom situation for one day prior to the 24 hr test that was intended to simulate a two-week period. Duties of each participant were known from the pretest instruction, and a group of local youngsters acted as victims. The rigorous maintenance of records was emphasized, including all incoming and outgoing communications. Wounded victims representing transfers from other shelters were brought in and given medical attention. It was felt that hospital staff personnel reacted very well to the physical demands of the attack simulation. (C.O.)

Legal Aspects

Refer also to abstracts 25254 and 25432.

25501 VOELKERRECHT IM ATOMZEITALTER. DER ATOMSPERRVERTRAG UND SEINE FOLGEN. (International Low in the Atomic Age. The Non-Proliferation Treaty and Its Results). Kimminich, Otto. Sozialwissenschaft in Theorie und Praxis. Freiburg i. B.; Verlag Rombach and Company GmbH (1969). 392p.

The influence of atomic weapons on international relationships is discussed. After analyzing the effects of acquisition of nuclear weapons by various nations on the world situation, efforts to prevent proliferation are outlined. Legal aspects of the Non-Proliferation Treaty are presented from the standpoint of non-nuclear nations, the problems of guaranty and inspection, safety measures, and the peaceful use of nuclear energy. Uncertainties about legality of the use of nuclear weapons in case of war are emphasized. (H.B.G.)

Medicine

Refer also to abstracts 25168, 25328, and 25343.

25502 RADIOISOTOPE GENERATORS AND ACCESSORIES (KITS). J. Biol. Med. Nucl.; 3: No. 14, 24-5(1968). (In French).

More and more radioisotopes of short half life are used in medicine. They are obtained from radioisotopic mother element of longer half life, fixed in an insoluble form in a chromatographic column. As they are produced they can be extracted by elution with a suitable solvent. Examples are ^{99m}Tc (6 hours) obtained from ^{99}Mo (67 hours) and ^{113m}In (1.7 hour) obtained from ^{113}Sn (111 days). However, radioisotopes obtained in this way are usually not clinically applicable, but must be converted into a chemically and physically suitable form for injection. For this reason, generating kits are now available containing not only the generator as such but also the necessary reagents, equipment, needles, and syringes. To make colloidal ^{99m}Tc at a suitable moment, the generator is milked and the proper amount of activity introduced into a flask containing the proper reactants. In 15 minutes a sterile and apyrogenic solution is ready for injection. With the help of such kits the doctor can easily prepare serum albumin solution labelled with ^{99m}Tc or with ^{113m}In or ferro-ascorbic acid complexes labelled with ^{99m}Tc. (F.J.W.)

Protective Substances

Refer also to abstracts 25390, 25405, 25562, 25572, 25576, 25582, and 25598.

25503 THE EFFECT OF CYSTAMINE ON THE GASTROINTESTINAL FUNCTION IN HEALTHY AND IRRADIATED RATS. Krasnykh, I. G.; Mansurov, A. R.; Razgovorov, B. L.; Tyutin, L. A. Farmakol. Toksikol.; 32: 696-8(1969). (In Russian).

Intraperitoneal injection of optimal protective doses of cystamine was studied roentgenologically on 80 rats in order to define the effect of the drug on the gastrointestinal function in healthy and irradiated animals. Irradiation without chemical protection was found to produce marked functional and morphological disorders in the gastrointestinal tract. Introduction of cystamine to healthy rats also led to considerable functional changes in the stomach and intestines, that depended upon the dosage of the drug. In the first hours prophylactic injection of cystamine before irradiation of the animals intensified spasms of the pylorus and the prepyloric portion of the stomach, but later on it exercised a clearcut normalizing effect on the gastrointestinal tract. (auth)

25504 TOXICITY AND RADIOPROPHYLACTIC ACTION OF 2-MERCAPTOETHYLGUANIDINE AND ITS DERIVATIVES IN MICE AND IN HeLa S_3 CELLS. Takagi, Yoshinari; Sato, Fumiko; Shikita, Mikio; Shinoda, Masato; Terasima, Toyozo; Akaboshi, Sanya (National Inst. of Radiological Sciences, Chiba, Japan). Radiat. Res.; 42: 79-89(Apr 1970).

Introduction of a methyl group(s) into N and/or N′ nitrogen of the guanido group of 2-mercaptoethylguanidine (MEG) significantly increased acute toxicity in mice of the mother compound. When compared on equimolar bases in some narrow ranges, N-methyl, N′-methyl, and N′,N″-dimethyl derivatives showed the same magnitude of prophylactic action against x irradiation in mice as MEG did. However, the radioprophylactic range of these compounds was obviously narrower than that of MEG. A derivative having three methyl groups at N,N′, and N″ was most toxic and no more radioprotective. Loss of reproductive integrity of x-irradiated HeLa S_3 cells was prevented by preincubation of the cells in a medium containing 20 to 30 mM MEG. On the other hand, proliferation of the cells was markedly inhibited by MEG itself, when the compound was present in the medium for a long period even in a concentration as low as 0.1 mM. The derivatives of MEG also protected HeLa cells against x rays, but to much less extents than MEG did. In addition, all these MEG derivatives were likewise less potent than MEG with respect to the inhibitory action on proliferation of HeLa cells. (auth)

25505 RADIOPROTECTIVE EFFECTS OF PHYTOUREASE. Hlavaty, V.; Dienstbier, Z. (Charles Univ., Prague). Experientia; 26: 84-6(15 Jan 1970).

Rats were exposed to 400 to 700 r of whole-body x radiation. Prior to exposure they were immunized by repeated injection of urease. In comparison with control animals, the urease immunized animals showed increased radioresistance. (H.B.G.)

25506 RADIOPROTECTIVE EFFECT OF PHYTOHEMAGGLUTININ IN MICE. Stefani, S. (Veterans Administration Hospital, Hines, Ill. Chicago Medical School). Experientia; 26: 80-1(15 Jan 1970).

Phytohemagglutinin was found to have a striking protective effect on mice exposed to near lethal doses of x radiation. Apparently, the degree of radiation protection was a linear function of the administered dose of phytohemagglutinin. (tr-auth)

Radiation Sickness and Injuries

Refer also to abstract 25256.

25507 TREATMENT OF POSTIRRADIATION EDEME IN THE COURSE OF X-RAY THERAPY OF CANCER OF THE LARYNX BY MEANS OF UNSPECIFIC STIMULATION. Dobrek, Z.; Skalska-Vorbrodt, J. (Inst. of Oncology, Gliwice, Poland). Nowotwory; 19: 285-8(Oct-Dec 1969). (In Polish).

Observations concerning zymosan treatment of postirradiation edemas in the course of x radiotherapy of cancer of the larynx are discussed. This zymosan treatment was applied in nine patients in which therapy with antibiotics and antiinflammatory agents was unsuccessful. In all nine patients the very marked diminishment of pain and dysphagia was accomplished. The laryngoscopy revealed a very marked improved or full control of edema in eight patients. The course of zymosan treatment was short (15 days on the average). (auth)

25508 CASE OF THE MONTH: RADIATION NECROSIS. Virginia Med. Monthly; 96: 488-93(Aug 1969).

A case of a 55-yr-old female with abdominal difficulties following radiotherapy for endometrial carcinoma is presented. After a sigmoid colostomy, then a resection of the small bowel and an anastomosis to the transverse colon, improvement was limited. Abdominal skin necrosis, a fecal fistula, and eventual death from sepsis occurred. A panel discussion of this case and other illustrative cases is reported. The problems of recognizing radiation-damage internal tissue, care in radiation techniques, and selection of proper surgical methods are considered. Recommendations for surgical treatment are made. For patients suffering from actinic enteritis and its complications during the first two years after radiotherapy, the following procedures should be used: for irradiation necrosis of the rectum and distal sigmoid, a Miles' resection and sigmoid colostomy should be done; for patients suffering from small bowel obstruction or small bowel perforation, the treatment should consist of excision of the entire diseased portion of the small intestine and an ileotransverse colostomy. In cases of actinic enteritis with symptoms developing after two years following radiotherapy, for those patients with intermittent or partial small bowel obstruction secondary to stenosis of the lumen, the procedure of choice is an ileotransverse colostomy. (C.O.)

25509 CONTROLLED CLINICAL STUDY OF METOPIMAZINE AND PERPHENAZINE IN TREATMENT OF RADIATION NAUSEA AND VOMITING. Chu, Florence C. H.; Paulshock, Marvin; Wallenstein, Stanley L.; Houde, Raymond W.; Phillips, Ralph (Memorial Hospital for Cancer and Allied Diseases, New York. Sloan-Kettering Inst. for Cancer Research, New York). Clin. Pharmacol. Ther.; 10: 800-9(Nov-Dec 1969).

A total of 252 outpatients receiving radiotherapy were started on a single-blind placebo medication for prevention of nausea and vomiting. Those who developed nausea or vomiting participated in a double-blind study to compare the relative antiemetic efficacy of metopimazine at two dose levels (2.5 mg and 5.0 mg) with perphenazine at two dose levels (4.0 mg and 8.0 mg) and with inert placebo. The results were analyzed in a variety of ways. The analysis of paired responses in the same patients showed that metopimazine in doses of 10 to 20 mg per day and perphenazine in doses of 8 to 32 mg per day were effective antinauseant-antiemetics significantly superior to placebo but not significantly different from one another. There were no significant differences in side effects among the test medications except for drowsiness, which occurred with a significantly higher frequency in patients receiving the higher dose of perphenazine. A method of population selection was proposed. A preliminary screening of patients by radiotherapists would eliminate from studies of antiemetics of large number of patients unlikely to develop nausea or vomiting after radiotherapy. (auth)

Radiodiagnosis

Refer also to abstracts 25283, 25285, 25341, 25357, 25492, 25579, and 25580.

25510 REDUCTION OF RADIATION AND EXPOSURE TIME IN MAMMOGRAPHY. Price, J. L.; Butler, P. D. (Royal Surrey County Hospital, Guildford, Eng.). Brit. J. Radiol.; 43: 251-5(Apr 1970).

The reduction of exposure time in mammography is important to reduce movement blurring, and low radiation dosage becomes significant in repeated examinations. The use of an x-ray tube with a rotating molybdenum anode results in a reduction in exposure time, as the molybdenum produces a larger radiation output, mainly characteristic radiation, than does tungsten at 30 kVp. A single film with a back-mounted high-definition intensifying screen, vacuum packed in a thin polyethylene envelope will allow a further reduction in exposure time and radiation dosage. This causes minimal loss of resolution, but this is compensated for by increased contrast in the film. By these means an exposure of 0.4 seconds at 30 kVp and 200 mA can be achieved using Ilford G film at 70 cm FFD. (auth) (UK)

25511 EVALUATION OF A DUAL RADIOISOTOPE URINARY EXCRETION TEST IN THE DIAGNOSIS OF PERNICIOUS ANAEMIA. Bell, T. K.; Lee, D. (Royal Victoria Hospital, Belfast). Acta Haematol.; 42: 183-7(1969).

A retrospective study of the use of a urinary excretion test following the simultaneous oral administration of free $^{58}CoB_{12}$ and $^{57}CoB_{12}$ bound to human gastric juice in 100 patients is reported. The test provides an accurate evaluation of the intrinsic factor status in over 90% of the patients studied. (auth)

25512 SINGLE INJECTION CLEARANCE IN CHILDREN. Sakai, Tadasu; Leumann, Ernst P.; Holliday, Malcolm A. (Univ. of California, San Francisco. San Francisco General Hospital). Pediatrics; 44: 905-11(Dec 1969).

The renal clearance of sodium iothalamate ^{125}I after a single intravenous dose of 10 to 25 μCi was calculated from the plasma disappearance curve. The endogenous creatinine clearance was compared with these results. Thirty-eight studies in 35 pediatric patients with all levels of renal function were performed. Eight studies were excluded because of grossly incomplete urine collection, and five studies were not analyzed further because of very low glomerular filtration rate. The correlation between both methods in the 21 studies was good ($C_{creat} = 0.91 \times C_{si} + 4.9$, $r = 0.91$). It was significantly better in the nine patients with a serum creatinine of 0.7 mg/100 ml or more ($C_{creat} = 1.01 \times C_{si} - 1.2$, $r = 0.97$) than in the 16 patients with a serum creatinine of 0.6 mg/100 ml or less ($C_{creat} = 0.82 \times C_{si} + 11.5$, $r = 0.84$). In the latter group, the accuracy of the serum creatinine determination was often poor, and even variations of ±0.1 mg/100 ml could lead to a gross error in the calculation of the clearance. In four patients, the clearance was obtained by external counting and agreed well with the clearance calculated from the plasma samples. The single injection clearance is especially indicated in children when no adequate urine collection is obtainable, at low serum creatinine concentrations, and in outpatients. (auth)

25513 ^{85}Sr SCINTIMETRY OF THE SPINE. Defiore, Joseph C. (Hospital for Special Surgery, New York); Lindberg, Lars; Ranawat, Nitranjan Singh. J. Bone Joint Surg.; 52A: 21-38(Jan 1970).

Strontium-85 step-scan scintimetry of the spine was performed in 123 patients with normal spines (twenty cases), osteo-arthritis (forty cases), compression fractures (twenty-seven cases), metastatic disease of the spine (ten cases), spondylitis (twenty-one cases), and Paget's disease (five cases). This method was found to permit precise topographic and quantitative evaluation of ^{85}Sr uptake of the spine. This method has value in: differentiation between recent compression fracture (high values) and older ones (six months) (normal values); evaluation of compression fractures secondary to pathological processes other than osteoporosis (high values); detection of occult metastases to the spine; evaluation of the activity of a spondylitic focus; and differentiation between spondylarthrosis (normal values) and specific disease entities (high values). (auth)

25514 USE OF ^{99m}Tc FOR FUNCTIONAL EXPLORATION OF THE THYROID. Ingrand, J. (Hopital Cochin, Paris). J. Biol. Med. Nucl.; 3: No. 12, 15-18(1968). (In French).

A critical review is presented of research on scintigraphic exploration of pathologic conditions of the thyroid by means of ^{99m}Tc, particularly in comparison with ^{131}I. Properties of ^{99m}Tc, important from a physiological viewpoint, are described. The short half-life of the diagnostically utilized metastable state of this isotope makes it necessary to "milk" the mother element, ^{99}Mo, adsorbed in a chromatographic column as molybdate, to obtain the pertechnate which is injected in physiological serum. Scintigraphy is carried out 30 min after injection of 1 mCi ^{99m}Tc and gives pictures of the same quality as those obtained with ^{131}I. While both isotopes are rapidly captured by the thyroid, ^{99m}Tc does not enter into organic connection with the gland, but disappears rapidly after reaching maximum concentration between 30 and 60 min after injection. This allows repeated tests in short succession, if needed under artificial stimulation or reduction of thyroid activity, and rapid results, while in working with ^{131}I, 24 hr must elapse between every test. On the other hand, ^{99m}Tc has certain limitations of applicability since, in contrast to ^{131}I, it shows only the concentration of ions circulating in the thyroid, but not hormone formation. A further disadvantage is that hypothyroidism, in contrast to hyperthyroidism, cannot be readily distinguished from the normal gland. (F.J.W.)

25515 SUPPRESSION OF LIVER IMAGE IN PANCREATIC SCINTIGRAPHY. Blanquet, P.; Beck, C.; Gillet, M.; Fleury, J.; Ferret-Bouin, P. (Laboratoires des Isotopes Hopital Saint-Andre, Bordeaux). J. Biol. Med. Nucl.; 3: No. 12, 12-14(1968). (In French).

The scintigraphy of the pancreas with ^{75}Se-selenomethionine is obstructed by the liver, which has affinity to the same tagged compound. To separate their images an electronic subtraction method was used, based on ^{75}Se and ^{198}Au. First, 250 μCi ^{75}Se-selenomethionine were injected and after half an hour the patient was placed under a PHO-GAMA scintillation camera adjusted to the common ^{75}Se and ^{198}Au peak. A double converter collects the X and Y amplitudes of the detector and codes them numerically. An integrating ferrit memory with 4096 channels classifies the numerical data, which are then stored according to space coordinates. A calculator transfers them on a magnetic band and allows subtraction channel by channel. The stored information is made visible on the screen of an oscilloscope on which the positive of the information is so long collected that at unit visibility a sufficiently dense picture is obtained. Then 250 μCi ^{198}Au are injected and the spectrum adjusted to 408 keV, the main peak of ^{198}Au. Owing to negative information storage, the liver image on the oscillographic screen gradually disappears which makes the appearance of the pancreas ever clearer. The screen is photographed with a polaroid film to obtain a permanent record. Since the time of maximum concentration of ^{75}Se in the pancreas depends on its pathologic condition, it is quite unpredictable. This method facilitates several images in rapid succession and thus offers a great advantage in catching a transitory phenomenon. (F.J.W.)

25516 SCINTIGRAPHY OF THE VASCULAR SYSTEM OF THE BRAIN (APPLICATION OF THE SCINTILLATION CAMERA AND OF TRIDIMENSIONAL ANALYSIS TO BRAIN SCINTIGRAPHY). Plagne, R.; Lafaye, C.; Jourde, H.; Meyniel, G. (Faculte Mixte de Medecine et de Pharmacie, Clermont-Ferrand, France). J. Biol. Med. Nucl.; 4: No. 16, 11-19(1969). (In French).

In the study of the circulation of the head and spinal column, the exploration of the brain by means of radioactive indicators comprises two types of examination: the functional study of blood circulation in the vascular system of the brain and the location of places of abnormal radioisotope fixation. Delayed appearance of activity may indicate thrombosis or other impediments of circulation. Thus a quantitative determination of blood flux is of great diagnostic value. The applied radioisotope should either have a short half-life (^{99m}Tc, ^{113m}In) or be rapidly eliminated (^{133}Xe). A small volume of the radioisotope solution should be brusquely injected and the passage of the embolus observed by scintigraphy from second to second. Multiple images allow the exact localization of abnormal circulation focuses. Tridimensional analyzers yield information suitable to quantitative interpretation by numerical treatment and allow comparison between circulation velocities between parts of the brain. An automatic timer preserves the information for each second. After the 4th second, the arterial activity becomes more and more diffuse and gives, after the 9th second, a homogeneous activity-distribution picture. After the 12th second, the veins become more and more visible, supplementing arterial information on hyper- and hypo-vascularization. Among the pathological conditions recognizable by time-lapse measurements, the following are mentioned: softening of the brain, thrombosis, hematoma, tumors, and post-operative metastases. (F.J.W.)

25517 COMPARISON OF ALBUMIN AND MACROAGGREGATED ALBUMIN LABELED WITH ^{99m}Tc AND ^{123}I, THE STUDY OF CARDIO-PULMONARY DYNAMICS. Drouet, J. (Centre National de Transfusion Sanguine, Paris); Goutheraud, R.; Amouch, P.-J.; De Vernejoul, P.; Barritault, L.; Kellershohn, C. J. Biol. Med. Nucl.; 4: No. 16, 21-5(1969). (In French).

For the purpose of camparison, studies were made with natural and denaturated albumin tagged with ^{99m}Tc, ^{123}I, and with ^{99m}Tc plus ^{125}I (the latter combination to measure the rapidity of ^{99m}Tc disintegration). Ten color photographs show the different accumulation of the two radioisotopes in characteristic organs of the human body and their activities at various times after injection. On the basis of these observations, half life, radiation energy, and chemical stability it is concluded that ^{123}I is preferable to ^{99m}Tc as tracer in the study of heart and lung function. ^{123}I permits radiographic examinations in rapid succession without danger to the patient. The albumin is readily dehalogenized by the pulmonary reticulo-endothelial system. Its longer half life is an additional advantage as it permits more time for manipulation, administration, and inspection. (F.J.W.) (TSS)

25518 STUDY OF MAINTENANCE OF HEPATIC FUNCTIONS OF PRESERVED LIVERS WITH THE LABELED ROSE BENGAL TEST. Ingrand, J.; Chapuis, Y.; Lenriot, J.-P. J. Biol. Med. Nucl.; 4: No. 16, 26-32(1969). (In French).

The main problem in liver transplantation is the preservation of functional integrity of the liver cells, which are extremely sensitive to lack of oxygen and other environmental changes. An important test for unimpaired liver function consists in the extraction of the radioisotopically tagged Rose Bengal-^{131}I from the perfusing solution. To study the dye uptake, a 400g liver was taken from an anesthetized and bled 15-lb dog. It was washed and kept immersed in Ringer-lactate solution in a tank at 5°C with and without oxygen pressure of 9 atm. For the purpose of perfusion it was decompressed and reheated to 37°C at which temperature it was perfused in a special apparatus with diluted blood solution at a portal pressure of 60 mm Hg and a flow rate of 1 ml per g and min. The perfusion lasted about 2 hours during which time a solution of 1 mg dye, tagged with ^{131}I at a strength of 20 μCi was introduced in the perfusion circuit. After 5, 10, 15, 20, 30, 40, 50, 60, and 90 min, 3 ml samples were removed and their activity was measured in a well crystal scintillation detector. The perfusion tests were terminated after 18 hr preservation at which time the preserved hepatic lobes were subjected to scintigraphy by a magnascanner II (Picker Nuclear). It was found that after 4 hr the Rose Bengal uptake of the preserved liver was very little changed and that even after 18 hr the uptake was satisfactory. It was noticeably better in hypothermically preserved livers than in those which also were kept under hyperbaric oxygen pressure. Scintigraphy of different lobes (6 color pictures are shown) confirmed these results. (F.J.W.)

25519 ASSEMBLY AND STUDY OF A DEFOCALIZED COLLIMATOR. PROPOSED PRACTICAL STANDARDS FOR THE DEFINITION OF A SCINTIGRAPHIC DETECTOR. Morin, Pp. (Ecole Nationale de Medecine, Brest, France); De Vernejoul, P.; Desgrez, A. J. Biol. Med. Nucl.; 3: No. 13, 11-16(1968). (In French).

One of the most difficult problems of medical scintigraphy is finding a collimator that gives a satisfactory resolution in depth of an area of low radioactivity in a thick organ. The requirements are: optimal total sensitivity towards very small amounts of radioisotopes, possibility for rapid scanning, small statistical variation, and contribution of each point of the scanned area to the total count corresponding to its own activity. It is particularly difficult to obtain a large area of isocount without reducing the resolving power. While focalized commercial collimators cannot be easily adjusted and are particularly unsuitable for the scintillation of organs of great thickness, the proposed defocalized collimators are shown in tests in water, air, and living human body capable of showing abnormalities in the depth of pulmonary tissues. The geometrical and optical characteristics of the defocalized collimators are described and illustrated by drawings. They have, in contrast to the commercial types, only a few channels in the form of truncated cones converging towards the collimator axis at focuses of 12 and 17 cm. These collimators were tested with the help of a vertically adjustable point source of spherical form and 2 mm diameter whose vertical distance from the collimator face could be easily adjusted. The radioisotopes with which the defocalized collimator was tested were ^{99m}Tc, ^{197}Hg, and ^{198}Au. Pulmonary scintigraphy on humans was carried out after injection of serum macroaggregates, labeled with ^{99m}Tc. (F.J.W.)

25520 APPLICATION OF RADIOIODINATED ROSE BENGAL AND COLLOIDAL RADIOGOLD IN THE DETECTION OF HEPATOBILIARY DISEASE. Rosenthall, Leonard. A Monograph in Modern Concepts of Radiology, Nuclear Medicine, and Ultrasound. St. Louis; Warren H. Green, Inc. (1969). 95p. $9.50.

The five chapters cover the following: physiology of rose bengal; radioiodinated rose bengal clearance as a test of hepatobiliary function; colloidal radiogold clearance as a parameter of liver perfusion in health and hepatobiliary disease; imaging the liver; and use of radioiodinated rose bengal clearance, and serial liver and abdominal scanning to differentiate extrahepatic obstructive jaundice and intrahepatic disease. A bibliography is provided at the end of each chapter and a brief index is included. (C.O.)

25521 INFLUENCE OF WATER AND MANNITOL LOADS ON RADIO-HIPPURAN RENAL FUNCTION CURVES. Farmelant, Melvin H.; Dukstein, Walter; Burrows, Belton A. (Boston Univ. Boston Veterans Administration Hospital). J. Nucl. Med.; 11: 186-9(May 1970).

Urine flow rate was altered in normal subjects by dehydration, water loading and administration of mannitol. The ^{131}I-Hippuran studies were performed in each condition. The time to peak and the half-time of the initial portion of the descending renal curve ($T_{1/2}$) were related to the urine flow rates. Above about 2 ml/min urine flow rate, changes in $T_{1/2}$ could largely be ascribed to changes in total renal clearance as determined from the half-time of a curve simultaneously obtained from the upper chest rather than to any effect of urine flow per se or of renal washout. Urine flow rate should be determined in clinical renography to properly interpret retention of radioisotope by a kidney. Flow rates above 2 ml/min are recommended to avoid distortion of the renal area curves. (auth)

25522 CONSECUTIVE DETERMINATION OF CARDIAC OUTPUT AND RENAL BLOOD FLOW BY EXTERNAL MONITORING OF RADIOACTIVE ISOTOPES. Razzak, Muhammad A.; Botti, Robert E.; MacIntyre, William J.; Pritchard, Walter H. (Case Western Reserve Univ., Cleveland). J. Nucl. Med.; 11: 190-5(May 1970).

The cardiac output and renal blood flow were determined consecutively in 87 subjects by means of external monitoring of ^{131}I-labeled human serum albumin and radio-Hippuran, respectively. The advantages of this technique, as well as its application for the bedside examination of cardiac output and renal blood flow in severely ill patients, are presented. In addition, repeated determinations could be performed at frequent intervals. These findings made it possible to study the course of patients after cardiac surgery as well as those suffering from myocardial infarction. (auth)

25523 TRANSPHARYNGEAL RADIOGRAPHY FOR ARTHRITIS OF THE MANDIBULAR CONDYLE. Toller, P. A. (Mount Vernon Hospital, Northwood, Eng.). Brit. J. Oral Surg.; 7: 47-54(Jul 1969).

A simple radiographic technique is described whereby a close anode distance favors a finely detailed bony shadow of the mandibular condyle free of the intervening shadows of hard structures. With the jaw open and slightly deviated, the x-ray beam is projected through the sigmoid notch and across the pharynx to a plain high-speed film without the use of intensifying screens. Radiation risks are discussed. Early remodeling changes in the head of the condyle can be detected. It is suggested that the technique may be of value in the assessment of clinical osteoarthritis of the mandibular condyle. (auth)

25524 COMPARISON OF ^{131}I-MACROAGGREGATED LIVER SCANNING AND SELECTIVE HEPATIC ARTERIOGRAPHY. Kirkham, Bruce C.; Tyson, Ian B.; Wirtanen, George W. (Univ. of Wisconsin, Madison). J. Nucl. Med.; 11: 196-202(May 1970).

Twenty-one patients with hepatic neoplasms receiving infusion of chemotherapeutic agents by intra-arterial hepatic catheters were studied with ^{198}Au liver scans, selective hepatic arteriograms, and intra-arterial ^{131}I-macroaggregated albumin (^{131}I-MAA) liver scans. The ^{131}I-MAA scans correlated with the hypervascular tumor areas on the arteriograms in 19 of 21 cases. The suggested mechanism is secondary to neovascular capillary blockage with delay in reticuloendothelial disposal of the aggregated particles producing positive images of abnormalities on the scans. The following patients are discussed: Three patients with increased uptake on the ^{131}I-MAA scans in the left lobe of the liver difficult to identify on arteriograms; four patients with normal ^{198}Au liver scans and abnormal ^{131}I-MAA scans; and six patients with shunting of ^{131}I-MAA to the lungs. (C.H.)

25525 SCINTIGRAPHIC PATTERNS OF LARGE AND SMALL PULMONARY EMBOLI. James, A. Everette Jr.; Eaton, S. Boyd; Potsaid, Majic S.; Fleischner, Felix G. (Massachusetts General Hospital, Boston). J. Nucl. Med.; 11: 214-16(May 1970).

A patient with pulmonary emboli on whom multiple pulmonary scintigrams were performed is presented and the changing pattern analyzed. Possible explanations for the evolving pattern depicted by the scintigrams are offered. (auth)

25526 APPLICATION OF ^{18}F TO IMAGE ^{226}Ra-INDUCED BONE LESIONS. Goldman, Marvin; Williams, R. Jean Romer; Bulgin, Marie S. (Univ. of California, Davis). J. Nucl. Med.; 11: 208-13(May 1970).

The toxicity of bone-seeking radionuclides is being evaluated in a colony of several hundred Beagles administered ^{226}Ra. Most of the toxic effects of ^{226}Ra poisoning appear related to the intensely ionizing, short-range alpha particles. The effects are primarily localized in the skeleton, including irradiated bone marrow. The diversity of skeletal lesions produced by ^{226}Ra, and the rapidity with which they appear (and in some cases disappear) radiographically, promoted an investigation of the possible correlation between bone blood flow and certain radiographically demonstrable lesions, using ^{18}F as the tracer. Fifty to 100 μCi of ^{18}F were administered to adult Beagles previously treated with ^{226}Ra. After 1 to 2 hr for plasma clearance, a series of positron scintillation camera pictures, 28 cm in dia, were taken using 1 to 5-min exposures. The photos were then assembled to reconstruct the outline of the skeleton. These revealed the appearance of hot spots over a variety of skeletal lesions. In areas such as epiphyses and highly trabecular bone that would be expected to have high concentrations of the radionuclide, there sometimes was an absence of uptake, suggesting impairment of the local bone blood flow. Results to date, including a preliminary correlation between the types of radiographically demonstrable lesions and their bone blood flow patterns, are summarized. (C.H.)

25527 EXHIBITION OF EQUIPMENT FOR ISOTOPE LABORATORIES (SHOWN AT THE TENTH ROUND TABLE ON THE EXPLORATION OF PHYSIOLOGICAL FUNCTIONS, GRENOBLE, SEPT. 20-21, 1968). J. Biol. Med. Nucl.; 3: No. 14, 20-3 (1968). (In French).

The exhibition, shown at the New Medical Building of the Medical Faculty of the University Grenoble, was organized by the Biophysical Laboratory in cooperation with the French Atomic Energy Commission, 14 industrial societies, the Nuclear Research Center in Mol, Belgium, and the Institute SORIN, Italy. Exhibited were many novelties such as assemblies for the preparation of ^{99m}Tc and colloidal ^{113m}In, and a ^{87m}Sr generator. The radioactive material was furnished by the French Atomic Energy Commission. The equipment was shown in three main groups: Detectors, electronic equipment, assemblies for clinical tests with radioisotopes, ionization chambers, well counters, amplifiers, pulse height analysers, liquid scintillation counters, and instruments for the measurement of low energy β- and γ-radiation; apparatus for the exploration of body functions: radiocardiographs, blood volume indicators, scanning devices, and assemblies for the radioisotopic examination and monitoring of bedridden patients; radiation protection devices: transistorized ionization chambers, protable multiple α-β-γ- and neutron detection and monitoring devices, enclosures for the sterile preparation of radioactive biological material, and the safe manipulation of radioactive substances. (F.J.W.)

25528 INTEREST IN ^{99m}Tc-IRON-ASCORBIC ACID COMPLEXES FOR RENAL EXPLORATION. Robillard, J.; Goussard, J.; Couette, J.-E.; Bloquel, J.; Cheguillaume, J. J. Biol. Med. Nucl.; 3: No. 14, 11-14(1968). (In French).

Rabbits weighing 2.5 to 3.5 kg received intravenous injections of 500 μCi ^{99m}Tc-labelled pertechnetate or 500 μCi of a solution of ^{99m}Tc-Fe-ascorbic acid and after one hour were scintigraphically examined in a ventral position. The pertechnetate was found located particularly in brain, salivary glands, thyroid, stomach, kidneys, and bladder so that no contrasting image of the kidneys could be obtained. However, the Tc-complex gave a clear picture of kidneys and bladder. The reason is that the Tc-complex accumulates predominantly in these organs and is more rapidly excreted than the pertechnetate. For this reason the Tc-complex lends itself particularly for the study of renal function in which 500 μCi Tc-complex were compared with 5 μCi iodine-131 labelled hippuran and showed parallelism of a 30 min lasting nephrogram. Clinical tests were made with Tc-compound scintigraphy and nephrograms on patients suffering of 58 diseases, 22 of the urinary tract, 13 of cancer of the uterus, and 23 others. The advantages of the use of the Tc-complex are considerable; injections of up to 10 mCi of the Tc-complex are well tolerated; renal absorption is greatly diminished; hepatic fixation is absent; the scintigrams show great clarity, and they can be combined with analysis of kidney function. (F.J.W.)

25529 THOROTRAST DEPOSITS IN THE RADIOGRAPH. Buettner, K.; Guenther, O. (Roentgeninstitut, Leipzig). Z. Aerztl. Fortbild., 60: 495-6(Apr. 15, 1966). (In German).

Typical x-ray findings from a case of thorotrastosis are presented and described. The patient was a 62-yr-old man with diagnosed liver cirrhosis. The spleen and liver were not enlarged, but showed a widespread area of a finely mottled appearance. Between the liver and spleen there were many areas that appeared to be calcified, located paravasally to the splenic artery and vein, that indicated Th deposition in the hepatolienal lymph nodes. There was a Y-shaped, almost calcified shading in the region of the liver hilum near the exit of the celic artery. The point where the Th probably was initially deposited was located in the right groin, and its appearance suggested a previous angiography. The radioactivity counts at the body surface were about 700/min over the liver and about 450/min over the spleen. No radioactivity could be detected in the blood. (BBB)

25530 ABNORMAL ISOTOPE CISTERNOGRAPHY IN SYMPTOMATIC OCCULT HYDROCEPHALUS. A CORRELATIVE ISOTOPIC-NEURORADIOLOGICAL STUDY IN 130 SUBJECTS. Heinz, E. Ralph; Davis, David O.; Karp, Herbert R. (Univ. of Pittsburgh). Radiology; 95: 109-20(Apr 1970).

Correlation between ^{131}I-albumin cisternography and traditional neuroradiological procedures was investigated in 130 patients with dementia or significant ventricular dilatation. In all patients with positive cisternograms, the results of the radiological procedures were either diagnostic or consistent with a diagnosis of obstructive hydrocephalus. The longer the duration of subarachnoid block, the less favorable the prognosis. (auth)

25531 A NEW RADIOPHARMACEUTICAL FOR CISTERNOGRAPHY: CHELATED ^{169}Yb. Wagner, Henry N. Jr.; Hosain, Fazle; DeLand, Frank H.; Som, Prantika (Johns Hopkins Medical Institutions, Baltimore). Radiology; 95: 121-5(Apr 1970).

^{169}Yb-DTPA, which has been employed for brain and renal studies, has now been used safely for cisternography in over 30 patients referred for investigation of hydrocephalus or rhinorrhea. It is physiologically stable and diffuses into the blood from the cerebrospinal fluid. Its biological half-life in CSF compartment is about ten hours, long enough for cisternography but short enough to keep the radiation dose low, even with millicurie doses. The radionuclide's long physical half-life, together with the stability of its complex, permits strict quality control. (auth)

25532 RADIOLOGY AND ORGAN TRANSPLANTATION. NEW HORIZONS FOR RADIOLOGISTS LECTURE. Starzl, Thomas E.; Vanhoutte, Jean J.; Brown, Donald W.; Taubman, John; Stears, John C.; Daves, Marvin L.; Halgrimson, Charles G. (Univ. of Colorado, Denver. Veterans Administration Hospital, Denver). Radiology; 95: 3-18(Apr 1970).

The discipline of radiology has played an indispensable role in the development and clinical application of transplantation procedures. The contributions have included radiotherapy, diagnosis, whole-body irradiation for immunosuppression, and research. Some of the wide-ranging activities of radiologists are reviewed, as these have been seen in a large transplantation program. (C.H.)

25533 DIAGNOSIS OF HEPATIC HEMANGIOMA WITH COMBINED SCANNING TECHNIQUE. Freeman, Leonard M.; Bernstein, Robert G.; Hayt, David B. (Yeshiva Univ., Bronx, N. Y. Misericordia Hospital, Bronx, N. Y.). Radiology; 95: 127-8(Apr 1970).

A combined liver-scanning technique with ^{198}Au and ^{131}I-HSA permits the evaluation of both hepatic parenchymal and blood pool elements. It is suggested that this method may be helpful in differentiating hemangiomata from other benign and malignant hepatic masses, particularly hepatoma. (auth)

25534 SECOND- AND THIRD-LOOK LYMPHOGRAPHY. ITS DIAGNOSTIC AND THERAPEUTIC VALUE. Gregl, Anton; Kienle, Juergen; Eydt, Michael (Univ., Goettingen, Ger.). Radiology; 95: 149-56(Apr 1970).

Second-look lymphography is a reliable method for the detection of new metastatic disease and the best control of therapy, especially in patients with tumors of the lymphopoietic system. No more complications or secondary effects may be expected after second-look lymphography than after the first study, nor does the procedure involve more technical difficulties in regard to dissection and cannulation of the lymphatics. Experience in 38 cases, in three of which a third-look examination was successfully undertaken, is reported. (auth)

25535 VERIFICATION ON THE PHANTOM OF VARIATIONS IN ISOTOPIC PLACENTAL LOCALIZATION. Carrat, S.; Henry, P.; Agnius-Delord, C. (Service des Isotopes Radio-Actifs du CHU, Grenoble, France). J. Biol. Med. Nucl.; 3: No. 13, 17-20 (1968). (In French).

The placenta of a pregnant woman is comparable to a sponge filled with 200 to 300g blood. When radioisotopes are introduced into the maternal blood stream, in form of ^{51}Cr labelled erythrocytes or Ir or Tc labelled serum albumins, the location of the placenta can be radiographically determined. However, the interpretation of the thus obtained pictures offers some difficulties since the higher counts are not strictly limited by the placental space, but also affected by peripheral and uterine blood vessels. Since the interfering radiation is not uniform, but depends to some degree on the location of the placenta, a series of tests was carried out on a phantom presenting the abdomen of a pregnant woman in order to allow a greater measure of certainty in determining the position of the placenta in vivo. The placenta was simulated by an artificial sponge in form of a flat cake soaked in a ^{51}Cr-containing solution. The sponge was covered by a plastic bag and inserted into a water-filled receptacle made from the large intestines of cattle which then was placed into the uterine cavity. Hereby all positions that a placenta could occupy were observed by means of the usual clinical procedures. Mappings of the radiographs of all these positions were made and 15 of them are shown in graphs. (F.J.W.)

Radiotherapy

Refer also to abstracts 25227, 25389, 25445, 25508, 25583–25585, and 25589.

25536 (BNL-14587) EXTRACORPOREAL IRRADIATION OF BLOOD IN THE TREATMENT OF CHRONIC LYMPHOCYTIC LEUKEMIA. Cronkite, Eugene P. (Brookhaven National Lab., Upton, N. Y.). 31 Mar 1970. 19p. (CONF-700308-1). Dep. CFSTI.

From Symposium on the Current Concepts in the Management of Lymphoma and Leukemia, Chicago, Ill.

Applications of extracorporeal γ irradiation of blood in the treatment of chronic lymphocytic leukemia are reviewed. It was concluded that the method has been beneficial in some individuals who had become refractory to chemotherapy. The response has been highly variable and in some individuals very encouraging and others very discouraging. (37 references.) (C.H.)

25537 RADIOTHERAPY OF LYMPH NODE METASTASIS. Umegaki, Yoichiro; Iida, Koyo (National Cancer Center, Tokyo). Gan No Rinsho, Suppl.; 197-201(Nov 1969). (In Japanese).

The principle and methods of radiotherapy of lymph node metastasis of cancer are discussed from the pathological viewpoint. The effectiveness of treatment was closely associated with the state of lymphatic metastasis; more than 50.0% healed without metastasis, decreasing to 20.0% with metastasis. The difficulty in treatment is attributed to the fact that metastatic lymph nodes are less sensitive to radiation and that the whole lymph nodes becomes cancerous, thus inhibiting the reactions of normal tissue to irradiation. Moreover, patients with metastasis are usually in a state of immune tolerance. The introduction of high-energy radiotherapy allowed the use of high doses for the treatment of large lesions. The combined use of linear accelerator and betatron proved to be most effective. The standard dose is 4,000 R/4 weeks in malignant lymphoma and 6,000 R/6 weeks in undifferentiated carcinoma. In adenocarcinoma and other tumors with low radiosensitivity of the lung, stomach, intestines, and breast, surgical treatment is essential due to extensive metastasis, with additional postoperative irradiation when necessary. Two cases that were successfully treated with high-energy radiotherapy are reported. (NSA of Japan)

25538 PRELIMINARY EVALUATION OF ^{222}Rn GAMMA RADIATION THERAPY IN HORSES. Dixon, R. T. (Univ. of Sydney). Aust. Vet. J.; 45: 389-94(Sep 1969).

In the form of needles, seeds, or molds, ^{222}Rn γ sources were employed in horses for therapy of chronic granulomatous lesions, neoplasms, and aseptic inflammations of bones, joints, and tendons. According to the disease, doses from 350 to 5000 r were administered. Satisfactory results were obtained in chronic granulomatous lesions and neoplasms. Inflammatory lesions showed occasional improvement. Radiation therapy was considered a valuable method in special cases but not a general replacement for conservative therapy or surgery. (H.B.G.)

25539 RADIOTHERAPY OF GENITOURINARY CANCER. Tsuya, Akira; Kawai, Tsuneo (Cancer Research Inst., Tokyo). Gan No Rinsho, Suppl.; 165-73(Nov 1969). (In Japanese).

The diagnosis and treatment of cancer of the testis, prostate, and bladder are discussed on the basis of review of the literature. Intravenous pyelography or lymphography are generally used in the diagnosis of testicular cancer. The treatment has to be decided according to the degree of metastasis and the histological type of cancer. Tumors with extensive hematogenous metastasis are contraindication of radiotherapy from the viewpoint of side effect caused by necessarily extended irradiation field. In bladder cancer, polycrystography, double contrast cystography and renoscintigraphy are used as diagnostic techniques. The size of irradiation field is most important in radiotherapy of bladder cancer. Late side effects include chronic cystitis, hemorrhage, contracted bladder, ulcer, and fistulization. In the treatment of prostatic cancer, for which radical surgery is generally impossible because of the difficulty in establishing diagnosis in early stage, telecobalt or high energy radiotherapy have been introduced. In addition, hypophysectomy or irradiation of the pituitary gland is used to suppress the pituitary functions. (NSA of Japan)

25540 RADIOTHERAPY OF TUMOR OF THE BONE AND SOFT TISSUE. Amino, Saburo (Tokyo Medical Coll.). Gan No Rinsho, Suppl.; 180-3(Nov 1969). (In Japanese).

The treatment of malignant primary tumors of the bone, i.e., osteogenic sarcoma, Ewing sarcoma, reticulum cell sarcoma, giant cell tumor, and those of the soft tissue, i.e., fibrosarcoma, liposarcoma, and synovial sarcoma is discussed. The prognosis of malignant bone tumors is rather poor due to the high incidence of hematogenous metastasis. However, improvement of therapeutic effectiveness is expected by the combined use of surgery, radiotherapy, and antineoplastic agents. Supervoltage irradiation is recommended since the difference in absorbed dose of the bone and muscular soft tissue can be proportioned and the radiation injuries to normal tissue can be minimized. More clinical studies are needed on dosage and overall time of preoperative irradiation. Histopathological examination prior to radiotherapy is important. Administration of antineoplastic agents or irradiation with 2,000 R before collecting the specimen is recommended from the viewpoint of hematogenous lung metastasis. In the course of radiotherapy, observation on serum Ca is important in detecting renal calculus. The principal treatment of cancer of the soft tissue is operative surgery. However, postoperative irradiation with electron beams and additional irradiation for local recurrence improve the effectiveness of treatment. (NSA of Japan)

25541 RADIOTHERAPY OF ABDOMINAL TUMORS, WITH SPECIAL REFERENCE TO INTRAOPERATIVE IRRADIATION. Onoyama, Yasuto; Abe, Mitsuyuki (Kyoto Univ.). Gan No Rinsho, Suppl.; 160-4(Nov 1969). (In Japanese).

The conventional therapeutic methods for cancer of the digestive system are briefly outlined and improved intraoperative irradiation is reported. The rather low status of radiotherapy in the treatment of abdominal cancer is attributed to the major histological type of tumor being adenocarcinoma with low radiosensitivity, the difficulty in setting the proper irradiation field including metastatic region, and possible exposure of the intestines and other highly sensitive organs to radiation associated with delivery of effective dosage. The limitations of conventional radiotherapy, including single irradiation, preoperative, and postoperative radiotherapy, can be considerably reduced by the intraoperative irradiation. The advantages are: direct view observation of tumors and metastatic regions permitting a precise irradiation field, and radiation exposure of the normal organs can be minimized by removing them from the field. Major indications include: palliative treatment of progressive tumors for which operative surgery is impossible; radical treatment of remnant metastatic regions; and extensive irradiation of microscopic remnant tumors for improvement of prognosis. Clinical experiences with 38 patients are also reported. (NSA of Japan)

25542 RADIOTHERAPY OF CANCER OF THE HEMATOPOIETIC SYSTEM. Kaneda, Koichi (Cancer Research Inst., Tokyo). Gan No Rinsho, Suppl.; 192-6(Nov 1969). (In Japanese).

Radical radiotherapy of malignant lymphomas including reticulosarcoma, lymphosarcoma, Hodgkin's disease, and giant follicular lymphoma is discussed. Malignant lymphomas are usually highly radiosensitive; standard tumor dose is 3,500 to 5,000 R delivered in 3 to 5 weeks, with slightly larger dose for reticulosarcoma. The field size has to be sufficiently large, since the failure of treatment is mainly due to the inappropriately small field size, which results in the emergence of new lesions in the marginal area. Lymphography is essential in deciding appropriate field size. Preventive irradiation is considered to be most effective in Hodgkin's disease. Other therapeutic methods presented include extended radical radiotherapy and radioisotope treatment. Prognosis is most favorable in primary tumors of the head and neck, and histologically in giant follicular lymphoma followed by reticulosarcoma, lymphosarcoma, and Hodgkin's disease with a five-year survival rate of approximately 50.0%. However, establishment of histological classification of lymphomas seems indispensable. Radiotherapy of other tumors of the hematopoietic organs such as acute leukemia, chronic myelogenic leukemia, chronic lymphogenic leukemia, and polycythemia vera in which chemotherapy has widely been used is also briefly discussed. (NSA of Japan)

25543 THE MORBIDITY OF RADICAL NECK DISSECTION CARRIED OUT AFTER IRRADIATION. Jortay, A.; Dor, P.; Smets, W. (Univ. Libre, Brussels). Bull. Cancer; 56: 197-212 (1969). (In French).

The post-operative progress of 139 cases of cervical lymph node removal following radiotherapy was compared with 301 cases done without pre-operative irradiation, with the object of determining to what degree a surgical intervention is influenced by pre-operative irradiation. The surgery was part of a planned, combined radio-surgical treatment in 39 cases, and carried out after cessation of radiotherapy alone (salvage surgery 82 cases) or after regress of the lesions following intensive chemotherapy (18 cases). Pre-operative irradiation led to an increase in both the frequency and the gravity of local complications: necrosis, infection, fistula and rupture of the carotid artery, in a proportion of cases that was related to the particular combination of irradiation and surgery that was used. Ways of preventing ischaemic necrosis and infection when operation after intensive irradiation is demanded by the extent of the original lesion were discussed. (auth)

25544 RADIOTHERAPY OF SKIN CANCER. Shigematsu, Yasushi (Osaka Univ.). Gan No Rinsho, Suppl.; 184-91(Nov 1969). (In Japanese).

The methods and problems of radiotherapy of cancer of the skin are discussed on the basis of clinical experience and the study of approximately 1000 cases treated at the Roswell Park Memorial Institute during the years 1964 through 1965. Potentiality of radical radiotherapy is found in almost all skin cancer, except malignant melanoma and cancer of the vulva, scalp, cicatrix, or the skin of the extremities. Tabulation of recurrence and incomplete regression of tumors indicated that incomplete regression of basal cell carcinoma was slightly higher than that of squamous cell carcinoma but no difference of statistical significance was observed in recurrence. In addition to superficial irradiation, the betatron and linear accelerator have been used for advanced cases. The standard schedules of dosage and overall time of radiotherapy are presented. The points for special attention include flexibility in therapeutic method and equipment in individual cases and the field size of tumors with obscure marginal region. (NSA of Japan)

25545 PROPANOLOL AND ^{131}I IN THE TREATMENT OF DIFFUSE THYROID HYPERPLASIA WITH HYPERTHYROIDISM. Franco, Jorge; Coppler, Marian; Kovaleski, Bernadine (O'Conner Hospital, San Jose, Calif.). J. Nucl. Med.; 11: 219-20(May 1970).

Eighteen consecutive patients with diffuse thyroid hyperplasia and thyrotoxicosis were treated with a single dose of 5 mCi of ^{131}I in capsule form and 10 to 40 mg q.i.d. of propanolol (a beta adrenergic blocking agent). Symptomatic improvement was immediate. There have been no laboratory or clinical relapses during followup periods of up to 16 months. The uniformly good symptomatic response and absence of side effects recommend additional evaluation of this combined therapeutic approach. (auth)

25546 EXAMINATION FOR A CORRELATION BETWEEN PROBABILITIES OF DEVELOPMENT OF DISTANT METASTASIS AND OF LOCAL RECURRENCE. Suit, Herman D.; Sedlacek, Robert S.; Gillette, Edward L. (Univ. of Texas, Houston). Radiology; 95: 189-94(Apr 1970).

Correlation between probability of developing local recurrence and distant metastasis following local x irradiation was studied using 12 mm diameter transplants of a mouse mammary carcinoma. Results showed that mice dying of metastatic tumor to lungs with gross local control had subclinical foci of viable tumor cells at the primary site with a frequency expected if local recurrence was not affected by metastatic tumor in lung. Contrariwise 12 of 13 mice dying of local recurrence had metastatic tumor at death. Amputation of the thigh when recurrence was first detected sharply reduced the frequency of metastasis to the lung. (auth)

25547 PARA-AORTIC LYMPH NODE IRRADIATION IN CERVICAL CARCINOMA. Silberstein, Allen B.; Aron, Bernard S.; Alexander, Leslie L. (Downstate Medical Center, Brooklyn. Kings County Hospital Center, Brooklyn). Radiology; 95: 181-4 (Apr 1970).

Cervical carcinoma metastatic to the para-aortic lymph nodes is generally considered incurable. Three of six patients with proved metastases are alive and well three to eleven years following irradiation. Para-aortic regions can be adequately treated with 6,000 rads in six weeks via a 360° rotational ^{60}Co γ treatment plan. Extensive surgery immediately prior to radiotherapy contributed to complications in one patient. Of five who lived at least one year following irradiation, more distant metastases developed in two. Over 85 per cent of patients with more distant metastases die within a year. Para-aortic metastases secondary to endometrial carcinoma may be treated similarly. (auth)

Blast and Thermal Effects

Refer also to abstract 25444.

25548 HIROSHIMA/NAGASAKI. Boffey, Philip M. Science; 168: 679-83(8 May 1970).

A brief review of the activities of the Atomic Bomb Casualty Commission is presented. The significance of findings in studies on long-term effects following the widespread devastation in Hiroshima and Nagasaki in 1945 is discussed. Cooperation between the Atomic Energy Commission, the U. S. National Academy of Sciences, and the Japanese National Institutes of Health in the design and operation of research programs is described. Studies on genetic effects and effects on newborn infants following exposure of mothers are discussed. A fixed population of about 100,000 persons was selected for study in Hiroshima and Nagasaki, some of whom had been exposed to the bomb and some of whom had not. This population serves as the base for three major research programs: life expectancy, pathology study, and adult health study. Long-term findings include an increase in general mortality exclusive of leukemia during the first ten years after exposure, a small retardation in growth and development, and infrequent radiation cataracts. Studies on the effects of shielding at the time of the explosion and the development of equations for estimating the radiation dose actually received by any given individual are discussed. (H.L.W.)

Radiation Effects on Animals

Refer also to abstracts 25399, 25407, and 25593.

25549 ACTION OF RADIATION OF RUBY AND NEODYMIUM LASERS ON NONPIGMENTED CELLS IN TISSUE CULTURE. Gamaleya, N. F.; Pasechnik, O. F. (Inst. of Experimental and Clinical Oncology, Kiev). Byull. Eksp. Biol. Med.; 67: 58-62 (Feb 1969). (In Russian).

Irradiation of monolayer HeLa cultures by a pulsed ruby laser causes destruction of the cell membranes with the formation of foci consisting of radially arranged fused cytoplasmic bands. The character of the foci of injury suggests that two different effects participate in it: thermal and kinetic. An important role in the action of radiation from the neodymium laser is played by the kinetic factor, evidently connected with the cavitation process. (auth)

25550 EFFECT OF X-IRRADIATION ON THE MITOTIC CYCLE OF IN VIVO CULTURED LYMPHOMA ASCITES CELLS. STUDY OF CELL KINETICS BY DOUBLE ISOTOPE LABELLING. Varga, L.; Varteresz, V. (National Research Inst. for Radiobiology and Radiohygiene, Budapest). Acta Biochim. Biophys. (Budapest); 4: 411-14(1969).

Postirradiation changes in cell kinetics on ascites lymphoma cells cultured in vivo were studied. Prior to irradiation the cells were incubated first with ^{14}C- then with ^{3}H-labeled thymidine. On the basis of the incorporation of precursors given at different time intervals, the population could be divided into 4 groups. The G_1-stage cells constituted the inactive group. Cells in the first half of phase S (ES) were labeled but with ^{3}H, those in the second phase (LS), with both isotopes. The G_2 stage cells constituted the ^{14}C-labeled group. The cells of the four groups were differentiated by autoradiography. Following x irradiation with a dose of 250 R, as soon as mitosis inhibition was released, the entering of the single cell groups into the M phase was studied by the labeled mitosis method. According to the results obtained, in the first postirradiation mitotic cycle at a given time, the cells of various stages enter the mitotic phase mixed. When compared with the control, the group-sequence also disappears. (auth)

25551 STUDY OF UV AND BLUE FLUORESCENCE ENHANCEMENT OF L-FIBROBLASTS IN VITRO AFTER X-IRRADIATION. Protsenko, M. I.; Ganin, A. F.; Gruzdev, A. D.; Mosolov, A. N. (Inst. of Cytology and Genetics, Novosibirsk, USSR. Medical Inst., Novosibirsk, USSR). Tsitologiya; 12: 214-19(Feb 1970). (In Russian).

L-fibroblasts were irradiated with x-rays (200 and 400 rad) and afterwards cultured in vitro. UV and visible blue fluorescences of cells were measured. A rapid increase of both types of fluorescence was found reaching its peak by the 3rd day; on days 15 to 20 this level decreased to the ones of the control values. (auth)

25552 RESPONSE OF WHITE MICE LIVER CELL MITOCHONDRIA ON THE ELECTROMAGNETIC FIELD IRRITATION. Zufarov, K. A.; Shnaivais, V. B. (Tashkent Medical Inst.). Tsitologiya; 12: 146-51(Feb 1970). (In Russian).

The ultrastructure of mitochondria was studied in mice liver cells following the influence of electromagnetic field of 1625 kh frequency. The initial changes on mitochondria involving their swelling could be traced during the treatment. Later, part of mitochondria underwent a lysis. In addition, some giant mitochondria appeared. Three days after treatment, mitochondria appeared to have mielin-like cristae as well as those transformed into mielin figures. (auth)

25553 PODKORKOVO-STVOLOVYE FUNKTSII PRI DEISTVII IONIZIRUYUSHCHEI RADIATSII NA ORGANIZM. (Subcortical-Stem Functions Under the Action of Ionizing Radiation on the Organism). Abdullin, G. Z.; Patalova, V. N.; Petelina, V. V.; Shkhinek, E. K. Leningrad; Izdatel'stvo Meditsina Leningradskoe Otdelenie (1967). 164p.

The preferential localization of injuries produced by ionizing radiation in the higher parts of the central nervous system and the significance of functional disturbances of subcortex and brainstem formations in controlling some vegetative and endocrine functions are discussed. Changes of functional state and of central control of pituitary-adrenal cortex system in radiation disease are analyzed. Pharmacological evidence of functional disturbances of subcortex and brainstem formations in irradiated animals is presented. The role played by subcortex and brainstem controlling mechanisms and processes of restitution in radiation disease are considered. (auth)

25554 COMPARATIVE RADIOSENSITIVITY OF ISOLATED NUCLEI OF THE BRAIN CELL ELEMENTS IN RATS. Kakhiani, E. D. (Inst. of Physics, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 53: 673-6(Dec 1969). (In Russian).

Using hypotonic, alkalic and thermal lesions of the isolated nuclei of neurons, astrocytes and oligodendrocytes in rats, the dose-effect curves were built. It was found that the nuclear membranes of astrocytes are twice as sensitive as those of neurons and oligodendrocytes. (auth)

Invertebrates

Refer also to abstracts 25415, 25464, and 25620.

25555 EFFECTS OF GAMMA- AND X-IRRADIATION ON THE TOXICITY OF MALATHION TO HOUSE FLIES. Whitacre, Gertrude K.; Ware, George W. (Univ. of Arizona, Tucson). J. Econ. Entomol.; 63: 424-6(Apr 1970).

Dosage-mortality studies on the combined effects of 5000 R gamma irradiation and malathion applied topically to adult house flies. Musca domestica L., indicated that newly pupated males, irradiated 4 days before emergence, were significantly more tolerant to malathion than when irradiated 2 or 3 days before emergence; female pupae irradiated 2 days before emergence are more tolerant to malathion than when irradiated at any other time. Gamma irradiation increased malathion tolerance more than x-irradiation in both males and females when pupae were irradiated with equal dosages. It is suggested that the increased resistance in flies from irradiated pupae may be attributed to increased detoxifying enzyme levels. (auth)

25556 SPERM UTILISATION AND RADIATION SENSITIVITY IN DROSOPHILA MELANOGASTER. Slizynski, B. M. (Mutagenesis Research Unit, Edinburgh). Heredity; 24: 660-5(1969).

Drosophila melanogaster males differ in the output of their spermatogenesis during the first 10 days of their life. There are three types of males: the first starts with high yield of offspring in the first matings followed by a steady, gradual decline, the second starts with high yield followed by a very slow decline and almost unchanged level of production, and the third that have the highest yield in the second batch of females followed by a rapid decline. These differences are naturally related to the variation in the duration of cell cycles and cell differentiations of spermatogenesis. Prolongation of cell cycles includes also prolongation of the sensitive stage that may result in more effective mutagenic action of x rays. Thus less prolific males are apt to be more responsive to x rays. (auth)

Vertebrates

Refer also to abstracts 25363, 25369, 25391, 25395–25398, 25400, 25401, 25405, 25406, 25408–25411, 25414, 25416–25418, 25428, 25468, 25503, 25504, 25526, and 25599.

25557 (BNWL–1221, pp 6.1-61) BIOLOGICAL EFFECTS OF INHALED PLUTONIUM. Clarke, W. J.; Howard, E. B.; Park, J. F.; Stuart, B. O.; Bair, W. J. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

The biological effects of inhaled plutonium in dogs are manifest principally in three tissues: the lung, tracheobronchial lymph nodes, and the circulating lymphocytes. Results are reported from studies that show death caused by inhaled ^{239}Pu, whether administered as PuO_2 or $Pu(NO_3)_4$, is caused by radioinduced fibrosis of the pulmonary tissue and the resulting cardiopulmonary insufficiency and/or bronchiolo-alveolar carcinoma. (C.H.)

25558 (BNWL–SA–3027) URANIUM MINE AIR CONTAMINANTS IN DOGS AND HAMSTERS. Stuart, Bruce O.; Willard, Donald H.; Howard, Edwin B. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). 14 Jan 1970. 29p. Dep. CFSTI.

In response to growing national concern over the increased incidence of lung cancer in uranium miners, a program of daily exposures of experimental animals was undertaken to determine the biological effects of repeated chronic inhalation of several potentially carcinogenic uranium mine air contaminants. The possible synergistic or contributory actions of short-lived radon daughters, carnotite ore dust, and diesel engine exhaust in the development of respiratory tract pathology were tested with six groups of 100 hamsters each. Each group was exposed for 6 hr daily to aerosols of: 30 Working Levels of radon daughters; 600 Working Levels of radon daughters; 600 Working Levels of radon daughters with 15 mg ore dust/m^3; diesel exhaust fumes; diesel exhaust with 600 Working Levels of radon daughters and ore dust; controls. Because nearly all of the uranium miners that have developed lung cancer have histories of cigarette smoking, experiments with beagle dogs were initiated to determine whether radon daughters and cigarette smoke inhalation may jointly cause respiratory tract damage. Three groups of 20 dogs received daily exposures to: the smoke of 10 cigarettes over a 16-hr period; cigarette smoking plus 4 hr of exposure to 600 Working Levels of radon daughters with 15 mg ore dust/m^3; 600 Working Levels of radon daughters with ore dust plus sham smoking. The current status of these long-term multiple exposure studies is described. (auth)

25559 (CEA-CONF–1481) RELATIVE BIOLOGICAL EFFECTIVENESS OF 14-MeV NEUTRONS: EXPERIMENTAL STUDY ON THE RABBIT. Haye, C.; Legeay, G.; Bazin, J. P. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). 1970. 12p. (In French). (CONF-700306–1). Dep. CFSTI (U. S. Sales Only).

From 21st International Congress of Ophthalmology, Mexico City, Mex.

Rabbit eye is a biological material particularly adapted to the study of correlation between the cataractogenic effect of ionizing radiation and absorbed dose. To demonstrate this relation, four stages of lens opacification were chosen: they take into account the rhythm of ophthalmological tests and allow the determination of latent period. Experimental data were analyzed by the probit method. Symmetrical parts were attributed to dose and time factors, similar hypotheses having been made about response functions for a given dose and at a given time. For the different stages of opacification, the 50% doses at a given time, and the 50% incidences for a given dose (or 50% latent time) were evaluated. These tests were made with γ rays and neutrons; the results were used to establish corresponding R. B. E. (France)

25560 (COO–1201-28) EFFECTS OF RADIATION AND OTHER FACTORS ON THE DEVELOPING FORM AND FUNCTION OF THE NERVOUS SYSTEM. Technical Progress Report. Hicks, Samuel P. (Michigan Univ., Ann Arbor. Dept. of

Pathology). Feb 1970. Contract AT(11-1)-1201. 11p. Dep. CFSTI.

The cerebellum of newborn rats was exposed to 200 to 400 R of radiation and the effects of radiation were compared with those following ablation of the cerebellum in infancy or at maturity. Both infants and adults were severely incapacitated by cerebellectomy. Radiation doses of 400R caused incoordination proportional to the extent of malformation of the cerebellar cortex. Visual-motor functions were studied in newborn rats following removal of the visual cortex and visual mid-brain centers; these animals were compared with those whose visual cortex was removed at maturity or irradiated at birth. Hemispherectomy was performed in adults and newborns to study aspects of bilaterally represented motor, sensory, and visual functions. Studies on irradiation of the eyes of newborn rats showed that 200 R produced an abnormal retina with a deficient yet doubled bipolar cell layer and photoreceptors arranged in rosettes. In spite of the malformed retina, the animal could visually gauge and jump variable distances to a small platform. (H.L.W.)

25561 (FOA-1-1481) EFFECTS OF DIFFERENT RADIATION INTENSITIES IN SUPER LETHAL DOSES ON MICE. Criborn, Carl-Olov; Roennbaeck, Curt (Forsvarets Forskningsanstalt, Stockholm (Sweden)). May 1969. 14p. (In Swedish). Dep. CFSTI (U. S. Sales Only).

The influence of whole body radiation with different dose rates, including super lethal doses on different physiological values, was studied in mice. Evaluations of changes in the ability to respond to sound impulse stimuli were performed. (auth) (SW)

25562 A PATHWAY TO PULMONARY FIBROSIS: AN ULTRASTRUCTURAL STUDY OF MOUSE AND RAT FOLLOWING RADIATION TO THE WHOLE BODY AND HEMITHORAX. Adamson Ian Y. R.; Bowden, Drummond H.; Wyatt, John P. (Univ. of Manitoba, Winnipeg, Can.). Amer. J. Pathol.; 58: 481-98(Mar 1970).

The ultrastructural changes which follow radiation of the whole body and thoracic cage were studied in mice and rats. The administration of chlortetracycline significantly lowered the mortality rates and by the elimination of bacterial pneumonia, allowed the observation of pure radiation damage. The earliest injury following 650 rad or 1100 rad to the whole body in mice involved vacuolation and subsequent destruction of capillary endothelium. Necrosis and stripping of the squamous (Type I) epithelium was an immediate sequel; Type II alveolar cells were not affected. The sequential intracapillary response involved platelet aggregation, focal occlusion, fibrosis, and recanalization. The changes were qualitatively similar to those observed in rats given 3000 rad to one lung. In both models the vascular changes and deposition of collagen occurred as a continuum. There was no latent interval between the initial cell injury and the mesenchymal reaction; fibrosis was established before the expected time of immunologic recovery. It is concluded that radiation-induced pulmonary fibrosis is the direct result of the primary vascular injury rather than a delayed immunologic response. (auth)

25563 PERFORMANCE OF MINIATURE PIGS AFTER PARTIAL BODY IRRADIATION. Thorp, J. W.; Chaput, R. L.; Kovacic, R. T. (Armed Forces Radiobiology Research Inst., Bethesda, Md.). Aerosp. Med.; 41: 379-82(Apr 1970).

Thirty-two miniature pigs were trained by shock avoidance conditioning to traverse a two-chambered shuttlebox. Eight unshielded pigs (whole-body exposed) received midline tissue doses (MTD) of about 13,000 rads of pulsed, mixed gamma-neutron radiations to the head and trunk. Eight head-shielded and eight trunk-shielded pigs received doses to the unshielded part of the body that were equivalent to the doses received by unshielded animals. Four trunk-shielded pigs received 6000 rads to the head, and four others received 3000 rads to the head. MTD behind the shield (at the middle of the head or trunk) was less than 7% of the MTD to the same point without a shield in place. Postirradiation performance was evaluated. All unshielded pigs suffered early transient incapacitation (ETI) or immediate permanent complete incapacitation (PCI); several early deaths (within 4 hr) occurred. Head shielding prevented ETI, immediate, PCI, and early deaths, but trunk shielding did not. However, trunk-shielded subjects that escaped the early death performed and survived longer than most head-shielded or unshielded pigs. ETI occurred in all trunk-shielded pigs that received 6000 rads and in one of four that received 3000 rads; however, early deaths did not occur and survival times were much longer than those previously reported for unshielded pigs that received comparable doses. (auth)

25564 THE EFFECT OF WHOLE BODY GAMMA IRRADIATION ON SURVIVORS' EGG PRODUCTION IN THE WHITE LEGHORN, COTURNIX COTURNIX JAPONICA, AND BOBWHITE QUAIL. Maloney, M. A.; Mraz, F. R. (Tuskegee Inst., Ala. Univ. of Tennessee, Oak Ridge). Contract AT-40-GEN-242. Poultry Sci.; 48: 1939-44(1969).

Mature White Leghorn, Coturnix and Bobwhite quail females were exposed to various combinations of rate of exposure and total dose levels of whole body γ irradiation. The irradiated birds laid significantly fewer eggs than the control groups during the first ten-day period following exposure to γ radiation. The effects of γ radiation on survivors' percentage egg production seemed to be related to the total dose of exposure rather than the rate of exposure. Recovery rate following exposure was linear in the White Leghorns and Coturnix. The mortality observed in this study seemed to indicate that the Coturnix and Bobwhite female are less sensitive to the lethal effects of whole body γ radiation than White Leghorn females, when the total dose level was 800 R or less and administered at the rates of 5 R, 25 R and 45 R per minute. (auth)

25565 CHANGES OVER TIME IN BLOOD BASOPHIL COUNTS OF X-IRRADIATED RABBITS. Thonnard-Neumann, Ernst; Taylor, Wilson L.; Nosan, Martin (St. Elizabeths Hospital, Washington, D. C.). Blut; 19: 537-44(1969).

Frequent determinations over several months explored the size and timing of changes in total white cell, basophil, and percentage basophil values in the blood of 11 male rabbits, six untreated controls and five given single-dose whole-body x irradiation of 300 R. The main results of analysis were as follows: Before exposure, the treated group did not differ significantly from the untreated group on any measure. Shortly after exposure, all three kinds of values for all irradiated animals dropped to initial minima that were significantly smaller than corresponding control minima. Thereafter, all kinds of values for all irradiated rabbits rose to a first set of maxima on days 10 to 13 after exposure, dropped to a second set of minima, then rose to near or above starting levels in months 2 to 4. In all treated rabbits the initial basophil drop was proportionately greater and the minima earlier, days 1 to 3, than the initial white cell minima, days $2^1/_2$ to $4^1/_2$. Derived basophil percentages fell even sooner, hours 6 to 12. The total white cell means of treated rabbits never regained their starting level, but basophil means neared theirs on days 8 to 15 and exceeded it in months 2 to 4. Meanwhile the basophil percentages of treated animals became significantly larger than those of controls on days 8 to 14, then rose even more, to 2.5 times the control level, in months 3 to 4. (auth)

25566 IONIZING IRRADIATION ON DEVELOPMENT OF THE MUSCLE SPINDLE. Bravo-Rey, M. C.; Yamasaki, J. N.; Eldred, Earl; Maier, Alfred (Univ. of California, Los Angeles). Exp. Neurol.; 25: 595-602(1969).

Intrafusal (IF) fibers in leg muscles of the rat increase in number from two at birth, to three at day 3, and to the adult four fibers by the sixth day. The question of whether this multiplication and the attainment of the adult complement of fiber nuclei involves mitotic division was approached by subjecting one leg of rat pups to x irradiation in single doses up to 1200 R, and comparing treated and control plantaris muscles on complete histological serial sections taken at 1 month of age. The mitotic process is particularly susceptible to ionizing irradiation and since periods for multiplication of IF fibers are fairly precisely scheduled, irradiation even in a single dose might be expected to disrupt future development. However, no effects were detected on number of spindles per muscle, on spindle complement of nuclear bag and chain fibers, or configuration of the nucleated region. Irradiation of gravid rats in the latter half of pregnancy with a single dose that was near lethal for the fetuses was also without obvious effect. Muscle spindles in several rat pups given single doses of colchicine were unaffected. Failure of these procedures to disturb spindle development supports the likelihood that the multiplication of IF fibers and allotment of nuclei that takes place in late natal and early postnatal periods is an amitotic process. (auth)

25567 HISTOLOGICAL EXAMINATION OF THE PERIODONTIUM IN THE IRRADIATION OF THE RAT TRUNK BY A DOSE OF 600 R. Klimek, H.; Krzywicki, J. Cesk. Stomatal.; 69: 198-202(Jul 1969). (In Czech).

Irradiation with a dose of 600 R of the rat trunk provokes impairment of dental apparatus. The intensity of pathological changes of teeth due to general irradiation proved to increase from the 5th to 25th day after exposure. The differences of the observed changes in postradiation pathology in single animals of the same group were observed as different individual resistance and susceptibility of the rats. (auth)

25568 HIGH ROENTGEN EXPOSURES (2000-8000 R) AND ANTILOCALIZATION OF SKIN-INJECTED PROTEIN. Kahn, Reuben L.; Miller, Norman S.; Botzler, Richard G. (Univ. of Michigan Medical Center, Ann Arbor). Radiat. Res.; 42: 188-94(Apr 1970).

Rabbit tissue exposed up to 8000 R had an antilocalizing characteristic for injected protein. It was found that skin exposures to 2000, 3000, or 4000 R of x rays showed markedly antilocalization of injected antitoxin, resulting in its increased escape and in the neutralization of toxin. Skin exposures to 5000 or 8000 R showed milder antilocalization of the antitoxin. This milder response might be due to the increased injury and inflammation resulting from the higher exposures, leading to increased localization. (auth)

25569 EFFECT OF DOSE AND PARTIAL-BODY X-IRRADIATION ON THE LETHALITY RESPONSE OF RATS TO LOW TEMPERATURE. Phillips, Richard D.; Carroll, Harold W. (Naval Radiological Defense Lab., San Francisco). Radiat. Res.; 42: 175-80(Apr 1970).

It was demonstrated previously that the median survival time (MST) of rats exposed to low temperature was decreased when cold challenge was immediately preceded by whole-body x irradiation. To determine if the decreased tolerance of irradiated rats to cold was the result of radiation damage to specific sites, partial-body irradiation studies were conducted. Survival times at −17°C were determined for groups of juvenile male rats that were exposed to cold within 130 minutes after x irradiation (1000 rad) of the head, body, hindquarters, or the whole body. The MST's of the head, body, and whole-body irradiated groups were similar, and were significantly less than that of the nonirradiated control group. No radiation-induced reduction in survival time in the cold was observed in the hindquarters-irradiated group, even though the irradiated mass was about twice that of the head group. After a radiation dose of 500 rad, cold tolerance was equally reduced by body or whole-body irradiation, but not affected when only the head received the same dose. It appears that the detrimental effect of irradiation on cold tolerance is not specifically related to the mass of tissue exposed, but to damage to specific sites. Furthermore, the head and body regions have differential sensitivities to irradiation for the induction of the lowered cold tolerance. (auth)

25570 INFLUENCE OF TEMPERATURE AND X-IRRADIATION ON THE CELLULAR DYNAMICS OF THE INTESTINAL EPITHELIUM IN COHO SALMON, ONCORHYNCHUS KISUTCH. Johnson, T. S.; Nakatani, R. E.; Conte, F. P. (Oregon State Univ., Corvallis. Battelle Memorial Inst., Richland, Wash.). Contract AT(45-1)-1830. Radiat. Res.; 42: 129-40(Apr 1970).

The intestinal epithelium of the Coho salmon was used to study the effects of temperature and x-irradiation on the cellular dynamics in a poikilothermic organism. Histological studies showed an absence of villi, and crypts in this system as only primary mucosal folds were observed. Autoradiographic studies following ^{3}H-thymidine (^{3}H-TdR) labeling indicated that intestinal epithelial cell replication occurs in basal proliferation zones of the intestinal folds and the mucosal cells migrate the entire length of the folds before being sloughed into the lumen. The renewal rates of the intestinal epithelium are temperature dependent and estimated to be 14 ± 1, 24 ± 1, and >35 days for 18, 10, and 5°C, respectively, as evidenced by autoradiographic and biochemical studies of ^{3}H-TdR incorporation and turnover of the nucleoprotein fraction. The uptake of ^{3}H-TdR into the nucleoprotein fraction was temperature dependent. Inhibition of ^{3}H-TdR incorporation into intestinal nucleoprotein by x rays was time and dose dependent; histological expression of radiation insult (≥1000 R) required approximately 25 days at 10°C and was typical of irreversible gastrointestinal syndrome. (auth)

25571 EFFECTS OF PRENATAL X-IRRADIATION ON THE ACQUISITION, EXTINCTION, AND DISCRIMINATION OF A CLASSICALLY CONDITIONED RESPONSE. Walker, Stephen; Furchtgott, Ernest (Univ. of Tenn., Knoxville). Radiat. Res.; 42: 120-8(Apr 1970).

In one experiment, rats exposed to 200 R on the 16th day of gestation took longer to acquire and extinguish a response conditioned to a 400-Hz tone but performed as well as controls in a 2-tone discrimination. The response studied was pushing open the door to a food compartment. In a second experiment, rats exposed to 100 R, but not those exposed to 50 R, differed significantly from controls during the acquisition of the conditioned response. The terminal level of performance was the same for the irradiated and control animals in both experiments. Prenatal irradiation seemed to influence primarily the speed of initial learning. (auth)

25572 EFFECT OF DIMETHYL SULFOXIDE ON X-RAY CONDITIONED SACCHARIN AVERSION. Chaddock, Th. E. (Florida State Univ., Tallahassee). Experientia; 26: 164-5 (15 Feb 1970).

Whole-body x irradiation of 40 female, 90-day-old Charles River rats was given at 250 kV, at a dose rate of 30 R/min to a total dose of 100 R. After sham irradiation, 20 of the rats had their tails immersed in dimethyl sulfoxide (DMSO) for 10 min. Irradiation alone led to a marked aversion to sodium saccharin. Treatment with DMSO lessened the effect of saccharin aversion in rats while having no effect on sham-exposed animals. The DMSO effects were not evident in the first 48 hr postexposure. Results suggest that a more sensitive measure of saccharin aversion is the extinction of the aversion rather than the traditional 48 hr preference test. (C.O.)

25573 EARLY EFFECTS OF MONOENERGETIC LOW-ENERGY ELECTRONS ON PIG SKIN. Lippincott, Stuart W.; Bender, Roger; Foelsche, Trutz; Azzam, Nabil; Montour, James; Rogers, Charles (Medical Coll. of Virginia, Richmond). Arch Pathol.; 89: 416-26(May 1970).

The early gross and histopathological effects of monoenergetic low energy electrons from 0.5 to 2.1 MeV on pig skin have been collated with depth dose and size of irradiated area. Exposures were made with proposed incident doses of 250, 500, 1,000, 2,000, and 5,000 rad. The size of irradiated areas was 2 × 2 cm, 4 × 6 cm, and whole trunk (about 35% of body skin surface). The data have been obtained to help establish limits of maximum permissible skin dose for man. No lesions resulted from 250 or 500 rad, and only a minimal moist desquamation in one instance at 1,000 rad. Gross lesions were produced by 2,000- and 5,000-rad doses. The time of appearance and extent of the lesions were related to both depth dose pattern and size of irradiated area. (auth)

25574 CYTOKINETIC EFFECTS OF ^{3}H AND X RAYS IN HAMSTER BASAL EPITHELIAL CELLS IN VIVO. Gibbs, Samuel Julian. Rochester, N. Y.; Univ. of Rochester (1969). 227p.

Thesis.

A quantitative multiparameter cytokinetic analysis was performed on a mammalian cell renewal system in vivo, the cheek pouch epithelium of the Chinese hamster. Kinetics of cell proliferation in the basal layer of cells and migration through the superficial differentiating layers in this stratified squamous epithelium were examined both under control conditions and following x irradiation in single and repeated doses, delivered locally to exteriorized cheek pouches. Mitotic activity in nontreated control animals was characterized by a pronounced circadian rhythm in the mitotic index, implying either considerable variation in rates of flow of cells through the mitotic cycle or partial synchrony in the dividing cell population. Statistical analysis of the spatial distribution of mitotic figures and of labeled nuclei in sections of the epithelium biopsied 1 hr after administration of ^{3}H-thymidine indicated that these distributions were significantly different from random, supporting the observation that proliferative activity tended to occur in localized areas, separated by zones of low activity. Tracer doses of ^{3}H-thymidine of high specific activity caused significant depression of the mitotic index within 2 hr after its administration, as labeled cells began to divide. This radioinduced mitotic delay from tritium decay was followed, as the wave of labeled mitoses ended, by supranormal mitotic activity in the form of an early rise in the circadian rhythm of the mitotic index involving division of nonlabeled cells. In nonirradiated animals practically all labeled cells divided between 2 and 10 hr after administration of ^{3}H-thymidine; significant migration of these cells from the basal began at 24 hr. The population of dividing basal cells was diluted by an unknown number of these cells not preparing to divide. For determination of parameters of the mitotic cycle these cells led to errors in the denominators (number of cells scored) of mitotic and labeling indices. Turnover of cells in the basal layer, determined by numerical integration of mitotic indices in nontreated controls, was 3.3 days; it could not be equated with generation time. The duration of DNA synthesis was determined by the wave of labeled mitoses method to be 10 hr, and by steady-state turnover methods to be 5 to 6 hr. The wave of labeled mitoses method gave an overestimate because of mitotic delay from ^{3}H-thymidine, the circadian rhythm, or both. The turnover method may have produced an underestimate because of the influence of the circadian rhythm on the dynamic steady state. X irradiation, 30 min after labeling with ^{3}H-thymidine, in single doses of 100 and 300 R caused mitotic inhibition beginning within 30 min of its administration; the magnitude was directly dose-dependent. Cumulative effects of second and third 100-R doses, given at 24 hr intervals, included mitotic inhibition dependent upon total dose and progressive shortening of the rhythm of mitotic activity, although its amplitude remained constant. Significant recovery between repeated doses was indicated by greater regeneration of mitotic activity in the 24 hr postirradiation period following three doses of 100 R than after a single dose of 300 R. Both recovery and cumulative effects may have been related to phase shifts in the distribution of proliferating cells in the mitotic cycle at the time of delivery of the second and third doses. The wave of labeled mitoses method was not an accurate means of measuring the length of the radioinduced G_2 block. X irradiation in the doses employed had significantly less effect on differentiation and migration of cells than on cell division. Only after a single dose of 300 R was the migration pattern of labeled cells noticeably delayed. (Diss. Abstr.)

25575 AGE RADIOSENSITIVITY OF OVARIES IN MICE. Gubareva, A. V.; Galkovskaya, K. F.; Kurbatova, T. I. (Central Research Roentgen-Radiological Inst., Moscow). Arkh. Anat., Gistol. Embriol., 56: No. 6, 57-60(Jun 1969). (In Russian).

A dose of 200 R of γ irradiation (GUT-^{60}Co-400) produced 100% castration in mice that had been exposed at the age of two and 12 weeks. Irradiation applied on the 14th to 15th days of embryogenesis did not produce ovary sterilization. The development of ovarian tumors in mice irradiated at the age of two weeks statistically exceeded in number neoformations of the organ in irradiated adult animals. (auth)

25576 DOSE RESPONSE CURVE FOR RADIATION-INDUCED LIFE SHORTENING. Yuhas, John M. (Jackson Lab., Bar Harbor, Me.). J. Gerontol.; 24: 451-6(1969).

The dose response curve for radioinduced life shortening was studied in two inbred strains of mice, A/J and C57BL/6J (total 2,374 mice). The experimentally observable area of the curve that can be studied was expanded through use of a radioprotective agent, WR-2721 (S-2-(3-aminopropylamino) ethylphosphorothioic acid) that protects against acute death more efficiently than it protects against the life shortening effects of radiation. While the exact protection that this agent offered against life shortening is impossible to quantitate, the maximum and minimum protection that it is offering can be estimated. Whether it is assumed that the actual protection this agent offers is equal to the theoretical maximum or the theoretical minimum, the shape of the dose response curve for radioinduced life shortening was shown to be dependent on the mouse strain studied. Life shortening is a linear function of radiation dose in the A/J mice in the low dose range and plateaus in the high dose range. In the C57BL/6J life shortening is a curvilinear function of radiation dose over the entire dose range, and life shortening values of 90% can be obtained with appropriate combinations of Wr-2721 and x rays. It is concluded that there is no single dose response curve for radioinduced life shortening that is universally applicable to all mice. (auth)

25577 DIFFERENTIATION AND DEGENERATION IN THE MOTOR HORN OF THE FOETAL MOUSE. Flanagan, Ann Elizabeth Harris (Cambridge Univ., Eng.). J. Morphol.; 129: 281-305(Nov 1969).

The development of the motor horn of the fetal mouse was investigated. A sampling technique was evolved using cresyl violet stained material. A decline in the number of motor neuroblasts occurred during the development, on each side, of four definitive motor regions from a single longitudinal column. The total number of motor horn cells fell from about 100,000 on the eleventh day after mating to about 25,000 on the fourteenth day. The early stages of this decline (between 11 and 12 days) are probably explained by the fact that not all neuroblasts in the region differentiate into motor cells; the later decrease can be entirely accounted for by the number of degenerations. Irradiation of the fetal mouse with a dose of 50 rads of ^{60}Co γ radiation resulted in an excess of about 20,000 differentiating motor cells on the thirteenth and fourteenth days. Irradiation increased the actual number, but not the percentage, of degenerations. This suggests that differentiation is a phase in the growth process that precedes degeneration. (auth)

25578 PATHOPHYSIOLOGICAL ALTERATIONS CAUSED BY COMBINED INJURIES. Messerschmidt, Otfried; Birkenmayer, Eline; Langendorff, Hanns (Univ., Freiburg i. B.). Atomkernenergie; 15: 74-6(1970).

Investigations in mice and rats inflicted with whole-body irradiations and additional skin wounds suggest a novel type of disease which is different from radiation syndrome. In these combined injuries the interval between injuries, as well as the sequence of irradiation and skin wound, played a special role, moreover there existed differences between species of animals. An operation preceding irradiation effected no increase of radiation lethality, sometimes even a decrease of lethality. If operation followed irradiation, however, a huge increase of lethality, suggesting an addition or even a raise to a higher power of the lethalities of the single injuries was observed. On the contrary, radiation lethality was increased in rats also in the case that operation is performed prior to irradiation. Lethality was only reduced if there was no long interval between irradiation and operation. Hematological and bacteriological investigations did not reveal any criteria for the pathogenesis of the increase of lethality found in mice. Histological investigations of the organs, however, indicated a severe shock state of the animals. For the decrease of lethality found in mice, a mechanism involving eventual adaptation of the hypophyso-adrenocortico-system is discussed. A satisfying explanation for the differing behavior of rats inflicted with combined injuries could not be given. (auth)

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Refer also to abstracts 25387, 25389, 25439, 25444, 25445, 25449, 25475, 25507, 25508, 25532, 25543, and 25548.

25579 BIOLOGIC EFFECTS OF IONIZING RADIATION AND THEIR CONSEQUENCES FOR MEDICAL PRACTICE. Wagner, Gerhart (Schweizerische Gesellschaft fuer Unfallmedizin und Berufskrankheiten, Basel). Z. Unfallmed. Berufskr.; 62: 168-77(1969). (In German).

Radiation effects on individuals and populations are discussed with respect to skin, hematopoietic system, gastrointestinal tract, gonads, and antibody system. Especially emphasized is the fact that in chest x-ray procedures, one third of the total bone marrow lies within the direct radiation field. Therefore, frequent diagnostic chest exposure should be applied only if absolutely necessary. During pregnancy, the most dangerous period comprises the first two weeks with respect to fetal death. Malformation, however, reaches a maximum at exposures around the 28th day. (H.B.G.)

25580 EVALUATION OF RADIATION EXPOSURE IN GYNECOLOGIC AND PEDIATRIC ROENTGEN DIAGNOSIS. Grossmann, H. Z. Aerztl. Fortbild.; 63: 215-8(15 Feb 1969). (In German).

Causes for mutation originating from man's modern environment are summarized and compared to possible mutagenic effects of diagnostic x-ray procedures. It is concluded that radiography is safe even in gynecology and pediatrics. Benefits to presently living individuals outweigh by far doubtful possible damage to the genetic pool of future generations. The responsibility of physicians as to both proper techniques in radiographic procedures and education of patients is discussed. (H.B.G.)

25581 NEPHROPATHY SECONDARY TO IRRADIATION. Campanacci, I.; Patrese, P.; Romagnoli, G. F.; Okolicsanyi, I.; Mendola, R. (Univ., Padua. Ospedale Civile, Padua). Folia Med. (Naples); 51: 905-33(Dec 1968). (In Italian).

Damage to kidneys of persons professionally exposed to radiation was reviewed. Renal function studies were performed on 24 patients who received ^{60}Co γ radiation to the kidney region. In comparison with routine x-ray exposure, the high-energy ^{60}Co γ radiation did not increase renal injury with respect to both incidence and severity. Minor pathological changes were noted that were either clinically asymptomatic or slightly symptomatic and were characterized by some decrease in the glomerular filtration. (H.B.G.)

25582 CUTANEOUS ARTERIOLAR DILATATION ELICITED BY ULTRAVIOLET IRRADIATION. Ramsay, Colin A.; Cripps, Derek J. (London Univ.). J. Invest. Dermatol.; 54: 332-7 (Apr 1970).

Arteriolar changes in the skin following monochromatic uv irradiation have been investigated with a photoelectric pulsemeter. Arteriolar dilation was seen at all wavelengths tested and could be detected as early as 2½ hours after irradiation. Intradermal epinephrine was found to produce marked pallor of uv erythema and arteriolar constriction was confirmed with the pulsemeter. Recordings indicating arteriolar dilation were identical with 250 nm and 300 nm erythema, despite well documented qualitative differences in the erythema at these wavelengths. (auth)

25583 RADIOTHERAPY OF UTERINE CERVIX CANCER. STUDY ON THE METHOD OF RADICAL IRRADIATION. Tazaki, Eisei; Oryu, Shinichiro (Tokyo Women's Medical Coll.). Gan No Rinsho, Suppl.; 174-9(Nov 1969). (In Japanese).

The standards for radiotherapy of cancer of the uterine cervix are discussed. The combined use of external and intracavitary irradiation is considered to be generally most effective. The standard treatment for external irradiation is to deliver 4,500 to 6,000 R fractionated in a weekly dose of 1,000 R with ^{60}Co or other high-voltage radiation in two-field irradiation. Various methods of intracavitary radiotherapy including the Stockholm method, and Manchester method, as well as the one developed by the authors are outlined. The combined use of intrauterine and intravaginal irradiation is recommended in most cases. In the early stage, intracavitary irradiation proved to be more effective in contrast to the heavier use of external irradiation in the advanced stage of cancer. The clinical experiences suggested that irradiation of the total pelvic cavity should be kept to the minimum because of the subsequent disorders of the bladder and rectum. The study on the cases of intrapelvic recurrence of cancer is also briefly presented. (NSA of Japan)

25584 PULMONARY FIBROSIS FOLLOWING RADIOTHERAPY FOR BRONCHOGENIC CARCINOMA AND HODGKIN'S DISEASE. Seydel, H. Gunter (American Oncologic Hospital, Philadelphia); Maun, J. Md. State Med. J.; 18: 61-2(Oct 1969).

The incidence of moderate to severe pulmonary fibrosis following radiotherapy for mediastinal Hodgkin's disease was 68% in 21 patients. The corresponding incidence in 20 patients with bronchogenic carcinoma was 75%. Severe symptoms occurred in 10% of the patients with Hodgkin's disease one year after radiotherapy, while the incidence of severe symptoms among the patients with bronchogenic carcinoma was 30%. No patients died due to causes arising from the pulmonary fibrosis. (auth)

25585 DEVELOPMENT OF A RETICULOSARCOMA AT THE LOCATION OF PREVIOUS RHINOFIBROMA WHICH WAS REMOVED AND IRRADIATED 17 YEARS AGO. Romitan, E.; Boici, V.; Romitan, R.; Ciortes, I. Z. Laryngol., Rhinol., Otol.; 48: 636-9(Aug 1969). (In German).

A patient with inflammatory changes in the nasopharynx developed a reticulum cell sarcoma and metastases on the right side of the neck seventeen years after an operation for a rhinofibroma and seven years after irradiation of a lymphoid tumor in the same location. (auth)

25586 RADIATION BIOLOGY, MEDICAL APPLICATIONS, AND RADIATION HAZARDS. Schwan, Herman P. (Univ. of Pennsylvania, Philadelphia). pp 215-34 of Microwave Power Engineering. Vol. 2. /Okress, Ernest C. (ed.). New York; Academic Press Inc. (1968).

The biological effects of microwaves on human tissues are reviewed. Medical applications in diathermy and diagnostic instruments are described. Hazards to man, especially the eyes, of exposure to strong sources of electromagnetic radiation are discussed. (41 references.) (auth)

25587 BIOLOGICAL EFFECTS OF RADIATION. Sykes, Peter. Manchester Med. Gaz.; 48: 22-5(May 1969).

The growing importance of radiation, particularly in medicine, is noted and the physical aspects of radiation are reviewed briefly. A review of the biological effects of radiation is given, beginning with cellular effects (lethality, DNA synthesis, mitosis, chromosome aberrations and gene mutations) and stressing local tissue damage. The consequences of the tissue response to irradiation, i.e., acute inflammation followed by slow healing, often with fibrosis, are discussed in relation to subsequent medical examination and procedures. Total-body irradiation results in both early effects and late effects. The early effects (cerebral, gastrointestinal, and hematopoietic syndromes) and late effects (cataract, sterility, fetal abnormality, and carcinogenesis) are reviewed briefly. (C.O.)

25588 ULTRAVIOLET AND VISIBLE ACTION SPECTRUM IN A CASE OF SOLAR URTICARIA. Ramsay, Colin A.; Scrimenti, Rudolph J.; Cripps, Derek J. (Univ. of Wisconsin, Madison). Arch. Dermatol.; 101: 520-3(May 1970).

A patient with solar urticaria had an action spectrum for immediate erythema and whealing which extended from 250 nm to 460 nm. The delayed erythema action spectrum was normal. Pulse-meter studies indicated that dilatation of cutaneous arterioles occurred with the immediate erythema; no kinins could be detected in the dermal perfusate from the area. The patient received psoralen therapy orally, and increasing exposure to natural sunlight increased his tolerance to sunlight. Monochromatic light tests showed that the minimal dose for whealing on exposed skin increased after treatment. (auth)

25589 EFFECT OF RADIATION IN HUMAN DENTAL TISSUES. Pietrokovski, Jaim; Azaz, Badri (Hebrew Univ., Jerusalem). J. Oral Med.; 24: 87-92(Jul-Oct 1969).

Thirty-five teeth were extracted from three patients that received large doses of irradiation to the head or neck areas as treatment for malignant tumors. The teeth were examined microscopically as well as histologically after extraction. The pulp of almost all the specimens were at different stages of degeneration, and irregular apposition and resorption lines were seen at the cementum. In the patients that were irradiated between 2½ and 5 years of age, constriction belts around the external surface of the teeth marked the time when radiation was administered; the tissues occlusal to these belts were formed before the patient had been irradiated, whereas the tissues apical to the belts developed during and after irradiation. The teeth extracted from the patients irradiated at adult age showed extensive carious lesions especially at their cervical region, and large degenerative changes at the pulp. (auth)

Radiation Effects on Plants

Refer also to abstracts 25403, 25441, 25447, 25450–25452, 25455, 25457, 25459, 25461, 25465, 25466, and 25469.

25590 THE EFFECT OF HIGH TEMPERATURES, GAMMA RAYS, AND FAST NEUTRONS ON VARIABILITY IN SOME QUANTITATIVE INDICES OF HARD WHEAT IN M_2. Sen'ko, V. P. (Inst. of Microbiology and Virology, Kiev). Tsitol. Genet.; No. 5, 466-7(1969). (In Russian).

Variability in stem height, the number of stems per plant, ear length, number of spikelets in an ear, and the number and weight of grains was studied in the Khar'kovskaya 46 variety of hard wheat. Grains were exposed to gamma rays (10 krad), fast neutrons (1 krad), and high temperatures (40°C for 30 days and 30° for 40 days). In general, the effect of ionizing radiation was more potent than the effect of high temperatures. For example, stem height decreased under the influence of both the ionizing radiation and high temperature, but this decrease was statistically significant only after ionizing radiation. The total number of stems per plant and the number of productive stems were the most variable characteristics, while ear length was the least variable. (JPRS)

25591 INCIDENCE OF PINE NEEDLE GALL FLY INFESTATION IN PINE SPECIES TWO YEARS POSTIRRADIATION. Nelson, Noel N.; Shields, Lora Mangum; Platt, Robert B. (New Mexico Highlands Univ., Las Vegas. Emory Univ., Atlanta). Bot. Gaz.; 130: No. 4, 226-30(Dec 1969). (ORO-2412-31).

The incidence of infestation by the pine needle gall fly (Itonida pinirigidae Pack) was established for two of three pine species at the Lockheed Airshield Reactor Site, Dawsonville, Georgia. Within a 25-ft-wide belt transect along a radiation gradient, three branches were obtained from all pine trees 6 to 12 ft high, since this gall fly infests primarily the younger trees. Significant increases in I. pinirigidae infestations of Pinus taeda and P. echinata Mill. were correlated with radiation exposures of 2,000 to 2,599 rads 2 years previously. No infestation was observed in P. virginiana Mill. Exposures of 125 to 199 rads appeared to stimulate growth in needle length. (auth)

25592 THE IMMEDIATE RESPONSE OF THE QUIESCENT CENTRE TO X RAYS. Clowes, F. A. L. (Oxford Univ.). New Phytol.; 69: No. 1, 1-18(1970).

Roots of Allium sativum and Zea mays were given 150 rads and 1800 rads of x rays respectively. Cells of the quiescent center respond at once by coming into mitosis although most are at G_1 before irradiation. There is a stimulation of DNA synthesis in the quiescent center, but not elsewhere, immediately after irradiation. Some cells, however, undergo mitosis without having synthesized DNA and this results in prophase and metaphase nuclei without the normal 4C complement of DNA. (auth)

25593 A STATISTICAL EVALUATION OF SPARROW et al.'s RELATIONSHIP OF D_0 TO CHROMOSOME VOLUME. Kaufman, Gary E.; Miller, Morton W. (The Univ. of Rochester, N. Y.). Radiat. Res.; 42: 181-7(Apr 1970).

An analysis was made of the data on the cellular radiosensitivity of 79 organisms, compiled and published by Sparrow, Underbrink, and Sparrow in 1967, to determine whether there was statistical justification for considering these data as falling into eight distinct groups, each characterized by an almost constant value of absorbed energy per chromosome at D_0. The 79 values of absorbed energy per chromosome were compared to sets of 79 random numbers generated with even probability over a log scale covering the same range. A parameter called error was defined to measure goodness of fit with the data arranged in eight groups. Error was calculated for Sparrow et al.'s data and for 5000 sets of random numbers. Of the 5000 random data sets, none had as small an error (as good a fit in eight groups) as did Sparrow et al.'s data. This finding was considered statistically significant, and it was, therefore, concluded that Sparrow et al. were correct in treating their data as eight groups. (auth)

25594 SIMULTANEOUS REACTIVATION OF ULTRAVIOLET DAMAGE IN XANTHIUM LEAVES. Cline, Morris G.; Conner, Gerald I.; Salisbury, Frank B. (Colorado State Univ., Ft. Collins). Plant Physiol.; 44: 1674-8(Dec 1969).

Experiments on Xanthium leaf discs were carried out to determine whether concomitant photoreactivation could be detected and if so, to compare its effects with photoreactivation due to postirradiation treatments. Attempts were made to simulate certain intensities of unfiltered solar radiation. A small but definite amount of simultaneous reactivation was observed. The dose reduction factor averaged 0.57. It was not clear whether the reactivation was due mainly to direct photoreactivation, photoprotection, or to heating effects. A much larger amount of reactivation due to postirradiation treatments (direct photoreactivation) was noted with the dose reduction factor averaging 0.30. (auth)

25595 EFFECT OF EXPOSURE FROM THE ACUTE GAMMA RADIATION ^{60}Co TO THE SOWING OF ACHENES ON THE INITIAL DEVELOPMENT AND GROWTH OF THE SUNFLOWER. Kovacik, A.; Skalska, R. (Inst. of Genetics and Plant Breeding, Prague). Genet. Slechteni; 5: 115-19(Jul 1969). (In Czech).

It is possible to affirm on the basis of tests and the values of growth intensities for the sunflower that there is a depressive phenomenon during inhibition of development and growth dependent on the time of sowing of the achenes after irradiation (acute ^{60}Co γ radiation). These depressive phenomena were most marked in the plants from achenes sown ten days after irradiation and to a lesser degree after immediate sowing and one day after being subjected to irradiation. The best development and growth was observed in the sunflowers from achenes sown three days and five days after irradiation. (auth)

25596 EFFECTS OF GAMMA-RAY IRRADIATION ON PROTEIN AND AMINO-ACID CONTENT OF MAIZE LEAVES. Singh, B. B. (Banaras Hindu Univ., India). Curr. Sci. (India); 39: 163-5(5 Apr 1970).

Healthy, uniform seeds of hybrid maize were exposed to ^{60}Co γ rays at doses of 0, 20, and 30 kR. After normal cultivation procedures, the total nitrogen of the leaves was determined by a modified Kjeldahl method and protein was calculated from the nitrogen values. Amino acid determination was dose chromatographically. The protein content increased with the doses of radiation; the highest content of 15.7% was obtained at 30 kR during ear formation. Protein content increased with age regardless of treatment. Amino acid contents increased markedly for arginine, histidine, aspartic acid, glutamine, cystine, tyrosine, tryptophan, and leucine when irradiated at 20 kR. Content of these amino acids remained constant at 30 kR. Valine content was reduced somewhat beyond 20 kR. Data are presented in tabular form and the possible mechanisms involved are discussed. (C.O.)

25597 EFFECTS OF γ-RADIATION ON POLLEN METABOLISM IN SOME MALLOW TYPE PLANTS. Kamalova, G. V.; Kandov, A. I. (Inst. of Experimental Biology of Plants, Tashkent). Dokl. Akad. Nauk Uzb. SSR; No. 9, 49-50(1969). (In Russian).

Dry seeds of *Gossypium hirsutum*, *Hibiscus manihot*, *Alcea rosea*, and *Malva silvestris* were ^{60}Co γ-irradiated (23 to 25 R/sec) in the presence of 10 and 20% solutions of Cu and incubated at 10 to 20°C. Analysis of pollen metabolism showed a stimulatory effect of irradiation under these conditions in *A. rosea* and neither stimulation nor inhibition in *M. silvestris*. Histochemical analysis of the pollen of these plants exhibited no deviation from normal. (R.V.J.)

25598 STUDIES ON RADIOPROTECTIVE ROLE OF DIMETHYL SULFOXIDE IN PLANTS. Kaul, B. L. (Max-Planck-Institut fuer Zuechtungsforschung, Cologne). Radiat. Bot.; 10: 69-78(Feb 1970).

Protection against damage caused by x rays in seeds of some crop plants by dimethyl sulfoxide has been investigated. Seeds of barley, wheat, and Triticale were treated with various concentrations of DMSO for four hr either before or immediately after irradiation with exposures up to 30 kR. A pretreatment with 10% DMSO (v/v) reduced the radiation induced seed lethality, seedling injury, and chromosome breakage. Post-treatments were, however, ineffective. Response of DMSO was not uniform but varied from one species to another, and the level of polyploidy of the organism did not show any influence on the efficiency of DMSO. X irradiation was also carried out either in the presence or on vacuum following DMSO treatment. Protection was found in both cases. However, the amount of protection was more in the presence of air. Dose–response curves drawn on the basis of seed lethality, seedling injury, percentage of normal cells and aberrations per cell in barley show a dose reduction factor of 1.3–1.5. It is pointed out that DMSO treatments give a definite protection against the initial radiation damage rather than stimulating the process of recovery. The probable mode of action is discussed. (auth) (UK)

25599 PRESENT POSITION AND PROSPECTS FOR NUCLEAR AGRONOMY. de Montagareuil, Guerin; Lamy, R. (CEN, Cadarache, France). Bull. Inform Sci. Tech. (Paris); No. 141, 3-10(Oct 1969). (In French).

The review of French research in nuclear agronomy from 1964 to 1969 is divided into specialized branches: water-soil relationships, soil-plant relationships, phytotechnology, agricultural radiogenetics, entomology, zootechnology and irradiation of food products. The analysis of the results obtained is approached from the angle of the technique employed. The section devoted to the biological effects of radiation will thus include everything concerning the improvement of plants, the eradication of insects and the preservation of food products. In the field of nuclear labels, more or less equal emphasis is laid on radioisotopes and on stable isotopes analyzed by mass spectrometry. A final chapter headed Analysis Under Radiation describes the work carried out or to be carried out in radioactivation analysis or on the nuclear measurement of moisture and soil density. (auth)

25600 RECOVERY OF VIABILITY AND RADIATION RESISTANCE BY HEAT-INJURED CONIDIA OF PENICILLIUM EXPANSUM LK. EX THOM. Baldy, Richard W.; Sommer, N. F.; Buckley, Patricia M. (Univ. of California, Davis). J. Bacteriol.; 102: 514-20(May 1970).

Spores heated in water at 54 C for up to one hr were plated on nutrient agar immediately or held for three days in aerated water at 23 C and then plated. Under these conditions, holding was optimal for recovery, increasing survival percentage up to 20-fold over values for immediate plating. Recovery was prevented partially or completely, however, when spores were held in any of the following solutions: glucose, potassium phosphate, ammonium or sodium acetate, sodium azide, or 2,4-dinitrophenol, or in the sodium or potassium salts of pyruvate, and tricarboxylic acid cycle acids. Both anaerobiosis and incubation at 0 C prevented recovery. Survivors of a heat treatment were more sensitive to gamma radiation than were unheated spores. Conditions which affected the recovery of viability had the same effect on restoration of radiation resistance. Thus, many of the processes for restoration of radiation resistance seem involved also in recovery of viability after heating. After a 99% inactivating treatment (about 30 min at 54 C), heated spores respired as fast as unheated spores, or faster. Malate, citrate, succinate, and acetate stimulated respiration in unheated spores and inhibited it in heated spores. (auth)

25601 EFFECTS OF GAMMA IRRADIATION ON GROWTH AND YIELD OF AGRICULTURAL CROPS. II. SPRING SOWN BARLEY AND OTHER CEREALS. Davies, C. R. (Agricultural Research Council, Wantage, Eng.). Radiat. Bot.; 10: 19-27(Feb 1970).

Plants of spring barley were exposed to acute doses of γ-irradiation, ranging from 250–2000 rads at various stages of the life cycle. Although there were quantitative differences between experiments, sensitivity to radiation was always greatest in plants irradiated at the vegetative stages of growth. Doses of 1000–2000 rads delivered at the 2- and 4-leaf stages of growth caused premature death, whilst plants exposed to these doses at the later stages survived. Lower doses delivered at the time of ear emergence or earlier caused the number of tillers to be increased by up to twice that of the control plants, although ultimately the yield of grain was reduced to an average of over 50 per cent. The severe reduction of yield in these plants was due to marked decreases in the number of ears and of the weight of individual seeds. Radiation had no effect on tillering in plants irradiated at anthesis or later and caused only a small reduction of seed yield. In studies on winter wheat and spring oat, similar though less severe effects of radiation were observed. Possible causes of the differences in the extent of radiation injury between these crops and those of wheat are discussed. (auth) (UK)

25602 EFFECTS OF GAMMA RAYS ON APPLE AND PEACH LEAF BUDS AT DIFFERENT STAGES OF DEVELOPMENT. II. INJURY TO APICAL AND AXILLARY MERISTEMS AND REGENERATION OF SHOOT APICES. Lapins, K. O. (Canada Dept. of Agriculture, Summerland); Hough, L. F. Radiat. Bot.; 10: 59-68(Feb 1970).

Injury to shoot apices and subsequent regeneration of injured tissues were studied in leaf buds of apple and peach that were exposed to γ rays at different stages of bud development, in the interval from developing buds at shoot tips to fully developed dormant buds. Radiation injury to apical and axillary meristems was manifested as deceleration or cessation of mitosis, untimely maturation and vacuolation of cells, pycnosis of nuclei, loss of cell contents, disintegration and collapse of cells, and distortion of the apex. Within the shoot apex, sensitivity to radiation injury decreased from promeristem, through peripheral meristem, to pith meristem. The most actively dividing cells were not necessarily the most sensitive cells to radiation, as the highest frequencies of cell divisions were recorded in the peripheral meristem. Within the promeristem of both the main apex and the axillary meristems, the second cell layer was the most sensitive to radiation injury and the first layer the most resistant. As no periclinal divisions were observed in the cells of the first layer, this layer played no part in the regeneration of the severely injured deeper layers of apple and peach bud meristems. In slightly injured apices, local or direct healing began by activation of individual cells. If injury were moderate, restoration of the central apical region began from the periphery—from flank and pith meristems. In severely injured apices with the central zone of apex killed, regeneration began from the flanks, in the area of the youngest leaf primordia or above this area. The center of regeneration (and mutations) was the main apex of the primary bud rather than axillary or accessory meristems. (auth) (UK)

25603 DECOMPOSITION OF IRRADIATED PERSIMMON LEAVES. Thomas, W. A. (Oak Ridge National Lab., Tenn.). Radiat. Bot.; 10: 7-10(Feb 1970).

The decomposition rate of leaves from neutron-gamma irradiated persimmon (Diospyros virginiana) trees did not differ significantly from that of nonirradiated leaves during the first 28 weeks in litter. Beginning in early May and extending through summer into autumn, the irradiated leaves decomposed faster than did the controls ($P < 0.025$). First-year weight loss from irradiated leaves, 62% ± 2, exceeded that from nonirradiated foliage, 48% ± 3. No differences existed in water-soluble losses from the two types of litter. The coarser texture of aberrant areas on irradiated leaves did not retard the rate of weight loss from those leaves. It is possible that convolutions in wrinkled areas of the irradiated foliage afforded concealment and a more favorable environment for decomposers. (auth) (UK)

25604 POTENTIATION OF GAMMA-RADIATION EFFECT BY 2,4-DINITROPHENOL IN BARLEY SEEDS. Gaur, B. K.; Joshi, R. K.; Joshi, V. G. (Bhabha Atomic Research Centre, Bombay). Radiat. Bot.; 10: 29-34(Feb 1970).

The influence of 2,4-dinitrophenol (DNP) on the radiation sensitivity of barley seeds was studied. Dinitrophenol concentrations that stimulated oxygen uptake brought about an increase in radiation damage. However, with higher concentrations there was a gradual decline in this potentiation leading to a reduction in radiation damage. (auth) (UK)

25605 THE EFFECT OF RADIATION ENERGY ON THE OXYGEN EFFECT IN IRRADIATED BARLEY SEEDS. Bottino, Paul James. Pullman, Wash.; Washington State Univ. (1969). 87p.

Thesis.

The role of linear energy transfer (LET) in the initiation of biological damage in irradiated cells is fairly well understood with densely ionizing particles in the energy range 5 to 15 MeV. However, this is much less understood with sparsely ionizing x and γ rays in the 50 kV to 1.25 MeV range. The latter was investigated for one of the oxygen dependent components of damage in the barley seed. Himalaya barley seeds were adjusted to various water contents ranging from 2% to 14% by storage in vacuum desiccators over calcium oxide or different concentrations of glycerin water solutions. The seeds were irradiated in vacuo in glass vials with 1.25 MeV ^{60}Co γ rays, and 300, 150, 100, and 50 kV x rays. The dosimeters were the Victoreen condenser R meter, and the standard Fricke dosimeter. After irradiation the seeds were hydrated either anaerobically in nitrogen saturated water or aerobically in oxygen saturated water. The effects of the treatments were recorded in terms of oxygen enhancement ratios (OER), M_1 seedling injury, frequencies of chromosome aberrations, and free radical signal as measured by electron paramagnetic resonance. The results may chiefly be explained on the basis of damage initiated by the products of interaction between free radicals and oxygen. In very dry (2.3%) seeds the OER's for seedling injury decreased with decreasing energy between 1.25 MeV and 100 kV. At 50 kV the OER increased to a value higher than at 1.25 MeV. This same relation occurred, but to a lesser extent, at 5.8 and 10.2% water content. Energy had no modifying effect at 14.0% water content. Chromosome aberration frequencies exhibited a similar relation. In the oxygen post treatments chromosome bridges and fragments per cell decreased from 1.25 MeV to 300 kV. There was a slight decrease from 300 to 100 kV, and then a significant increase at 50 kV. In the nitrogen post treatments the bridges and fragments per cell increased steadily as the energy decreased from 1.25 MeV to 50 kV. Seedling injury exhibited the same response as the chromosome aberration frequencies. Electron spin resonance measurements revealed that the radical signal decreased between 1.25 MeV and 300 kV, plateaued between 300 and 150 kV, and then greatly increased at 50 kV to a value higher than the value for 1.25 MeV. The effects of radiation energy were compared in 100% and 12.5% oxygen post treatment. It was found that the small differences present with 100% oxygen disappeared in 12.5% oxygen. For energies between 1.25 MeV and 150 kV there was no detectable difference in the rate at which oxygen dependent damage decreased with post irradiation storage. At 50 kV, however, there was an initial rapid decrease in damage followed by a rate of decrease similar to the other energies. One plausible interpretation for all the data is that as energy decreases from 1.25 MeV to 100 kV the energy absorption decreases slightly and the pattern of energy deposition becomes more restricted, bringing about a decrease in the amount of radicals formed. This decrease is particularly notable between 1.25 MeV and 300 kV. At 50 kV there is a sharp increase in the energy absorption resulting in an increase in the quantity of radicals. The change in total energy absorption and in pattern of deposition (or absorption) with change in energy might be related to delta rays being more effective in producing free radicals at the lower energies than at the higher energies. This greater effectiveness in turn may be due to increased energy absorption through the Auger and Compton components of interaction of ionizing radiation with matter. The increased energy sorption may be at least in part due to the radiolysis of water present in the seed since it is known from studies in aqueous solutions that water shows increased energy absorption around 50 kV. (Diss. Abstr.)

25606 EFFECT OF CYCLOHEXIMIDE, GAMMA IRRADIATION, AND PHOSPHORUS DEFICIENCY ON ROOT PRESSURE EXUDATION IN TOBACCO. Wallace, A.; Ashcroft, R. T.; Leo, M. W. M.; Wallace, G. A. (Univ. of California, Los Angeles). Plant Physiol.; 45: 300-3(Mar 1970).

Cycloheximide drastically reduced the rate of root pressure exudation in detopped tobacco (Nicotiana tabacum L.), and the effect was more pronounced for nitrate salts in the external solution than for some other salts or when the roots were in water. Diurnal periodicity was greatly decreased, and its phase was changed. Effects began within an hour. Cation uptake was reduced by relatively low levels of cycloheximide. The effects of cycloheximide seemed to be reversible. Mild phosphorus deficiency resulted in decreased exudation rates from detopped tobacco and in no response to nitrate. Periodicity of exudation was not greatly affected by phosphorus deficiency, however. Gamma irradiation with a ^{60}Co source at levels (up to 40–50 kiloroentgens) which are considered disruptive of moderately large molecules had relatively little effect on the exudation rate. Higher levels of irradiation, which disrupt most protein molecules, decreased exudation and obscured periodicity. The results indicate either that new protein (or peptide) synthesis is needed for the rapid nitrate transport or that the deficiency and inhibitor disrupt cellular membranes. Phosphorus deficiency increased the sensitivity of the plants to inhibition by irradiation of the exudation process. (auth)

25607 RADIOSENSITIVITY OF TUBERS AS A FUNCTION OF THEIR PHYSIOLOGICAL CONDITION. Serebrenikov, V. S. (All-Union Inst. of Electrification of Agricultural Industry, Moscow); Kiryukhin, V. P.; Lur'e, L. S.; Voropaev, Yu. B. Vestn. Sel'skokhoz. Nauki (Moscow); No. 6, 82-5(1968). (In Russian).

The effects of doses of γ radiation ranging from 25 to 500 rad on the development and yield of potatoes following exposure of sprouting and non-sprouting tubers were studied. The results showed that doses of 50 rad had a stimulating effect on the growth of the tubers that was more marked for sprouting than for non-sprouting tubers. The yield of potatoes from irradiated tubers was increased and the content of starch and vitamin C was greater than in potatoes from non-irradiated tubers. (R.V.J.)

25608 EFFECT OF COSMIC RAYS ON PLANTS. Nizam, Jafar (Osmania Univ., Hyderabad, India). Nucleus (Calcutta), Suppl.; 224(1968).

From International Seminar on Chromosome, Its Structure and Function, Calcutta, India. See CONF-680846.

Specimens of desmids, chlorococcales, and seeds of Acanthaceae were exposed to cosmic radiation at an altitude of 125,000 ft. Abnormal forms of desmids were observed and colonies of chlorococcales were disintegrated. Increased cell dimensions and early flowering were observed in Acanthaceae. Root tip cells grew to more than twice their normal size in all species. Cytological investigations did not reveal any chromosome aberrations. (H.L.W.)

Radiation Effects on Microorganisms

Refer also to abstracts 25392, 25440, 25442, 25446, 25453, 25454, and 25456.

25609 EFFECT OF TEMPERATURE ON RADIOSENSITIVITY OF NEWCASTLE DISEASE VIRUS. DiGioia, G. A.; Licciardello, J. J.; Nickerson, J. T. R.; Goldblith, S. A. (Massachusetts Inst. of Tech., Cambridge). Appl. Microbiol.; 19: 455-7(Mar 1970).

Newcastle disease virus was irradiated at temperatures ranging from 2.2 to 60 C. An interaction between the thermal and ionizing energy was observed in the temperature region of 49 to 60 C. At 2.2 C, the hemagglutinin was considerably more radioresistant than the infectivity property. It is believed that radiation inactivation of Newcastle disease virus infectivity at low temperatures was due to nucleic acid degradation and at higher temperatures was due to protein denaturation. (auth)

25610 INTERACTIONS IN THE RECOVERY OF SALMONELLA TYPHIMURIUM DAMAGED BY HEAT OR GAMMA RADIATION. Corry, Janet E. L.; Kitchell, A. G.; Roberts, T. A. (Meat Research Inst., Bristol, Eng.). J. Appl. Bacteriol.; 32: 415-28(Dec 1969).

Growth of two strains of Salmonella typhimurium in nutrient broth, selenite and tetrathionate broths, at 37 and 43°, after damage by heat or γ radiation, was compared with that of undamaged cells. Counts at 37° were made on 6 media initially and after enrichment for 24, 48, and 72 hrs. Analyses of variance showed complex interactions of cell damage, enrichment medium, temperature and duration of enrichment, and plating medium. The most generally satisfactory combination of factors involving use of selective inhibitors appears to be enrichment in tetrathionate broth at 37° followed by plating at 48 hrs. on brilliant green, Wilson and Blair, or brilliant green-phenol red agar. After attaining maximum numbers in 18 h in selenite broth, salmonellae died off rapidly or, if heat damaged, may fail to grow at all in this enrichment medium. Incubation at 43° in either selenite or tetrathionate medium, except after pre-enrichment, is not recommended for heat damaged salmonellae. (auth)

25611 EFFECT OF IRRADIATION TEMPERATURE ON INACTIVATION OF CLOSTRIDIUM BOTULINUM TOXIN TYPE E BY GAMMA RAYS. Licciardello, J. J.; Ribich, C. A.; Goldblith, S. A. (Massachusetts Inst. of Tech., Cambridge). J. Appl. Bacteriol.; 32: 476-80(Dec 1969).

At an irradiation temperature of 32°F the inactivation curve for Clostridium botulinum type E toxin was characterized by an initial lag for the first 2 Mrad followed by an apparent linear portion represented by a D_{10} of 2.1 Mrad. The effect of irradiating at temperatures up to 117.5°F was only to shorten or eliminate the initial lag. A synergistic effect of irradiation temperature was indicated at 91.4 and 105.8°F, but at 117.5°F the toxin appeared more radioresistant. (auth)

25612 CHANGES IN RESISTANCE TO RADIATION AND HEAT DURING SPORULATION AND GERMINATION OF CLOSTRIDIUM BOTULINUM 33A. Durban, E.; Goodnow, R.; Grecz, N. (Illinois Inst. of Tech., Chicago). J. Bacteriol.; 102: 590-2(May 1970).

During sporulation, Clostridium botulinum 33A developed resistance to ultraviolet and gamma rays about 2 hr prior to its development of heat resistance. During germination, loss of resistance to heat, ultraviolet radiation, and gamma radiation occurred essentially simultaneously. (auth)

25613 AN ELECTRON MICROSCOPE STUDY OF MESOSOMES IN IRRADIATION-RESISTANT MUTANTS OF ESCHERICHIA COLI. Pontefract, R. D.; Thatcher, F. S. (Food and Drug Directorate, Ottawa). J. Ultrastruct. Res.; 30: 78-86(1970).

Actively growing cells of irradiation-resistant mutants of Escherichia coli appear to form mesosomes similar to those formed in normal E. coli. However, lag phase cells of the mutants contain many large, complex organelles that become smaller and reduced in number as the cells enter the logarithmic phase of their growth. Since these lag-phase cells are mostly long filamentous organisms that contain a number of complete genomes, it is believed that the complex organelles are mesosomes developed in response to the genomes present in each long cell. As cellular division and genome separation occur at various points along the length of the filamentous cells, some of the mesosomes become active in nuclear division while others, removed from these sites, are not used, and disintegrate. (auth)

25614 RESISTANCE OF A YEAST-LIKE FUNGUS PULLULARIA PULLULANS (DE BARY) BERK. TO THE LETHAL AND MUTAGENIC ACTION OF UV AND X-RAYS. Koval'tsova, S. V.; Zakharov, I. A.; Levitin, M. M. (Ioffe Inst. of Physics and Tech., Leningrad. All-Union Research Inst. of Plant Protection, Leningrad). Tsitologiya; 12: 233-7(Feb 1970). (In Russian).

The resistance of a yeast-like fungus Pullularia pullulans to uv and x-irradiation was compared with that of diploid strains of Saccharomyces cereviseae. The results obtained revealed a high resistance of P. pullulans to lethal uv and x-irradiation; at uv and x-irradiation LD_{90} was found to be 10,000 erg/mm^2 and 170 to 225 kr, respectively. At the same time, for diploid strains of yeast the corresponding values were 3000 erg/mm^2 and 85 kr. The high resistance of P. pullulans was also revealed following the mutagenic action of UV-light (induction of reversions to adenine-independence). P. pullulans was regarded as an organism extremely resistant to irradiation. (auth)

25615 PHOTOREACTIVATION KINETICS OF ESCHERICHIA COLI B/rWP2 AND B_{S-1} STRAINS SUCCESSIVELY IRRADIATED WITH α- AND UV RAYS. Zavol'naya, E. S. (Inst. of Cytology, Leningrad). Tsitologiya; 12: 220-32(Feb 1970). (In Russian).

Photoreactivation kinetics was studied with two strains of E. coli: a radioresistant mutant B/rWP2 and a hypersensitive mutant B_{S-1}. The speed of photoreactivation process was found to decrease when cells of B_{S-1} were preliminarily irradiated with α-rays (40 krad). However, under equal conditions, the photoreactivation velocity of the strain B/rWP2 increased. At the same time, the irreparable component of photoreactivation increased for both strains. It was supposed that the decrease in photoreactivation velocity of the strain B_{S-1} and the increase of irreparable component for the two strains may be a sequence of a partial damage of photoreactivation system by α-rays. The increase of photoreactivation velocity as the result of preliminary α-irradiation for the strain B/rWP2 may be due to the presence of two kinds of repair mechanisms in this strain; photoreactivation and dark restoration; the dark repair mechanism being suppressed with α-rays, the conditions that appeared in the cell favored a quicker photoreactivation. Alterations in the photoreactivation kinetics of the two strains following treatment with uv only allowed a suggestion that a photoreactivation enzyme is not destroyed with uv. The increase of irreparable component in this case was explained by accumulation of non-photoreactivable damages. (auth)

Radiosterilization and Radiopreservation

Refer also to abstracts 25388 and 25390.

25616 (CEA-Bib-178) WHOLESOMENESS STUDIES RELATIVE TO IRRADIATED STARCHY FOOD AND SUGARS. Berger, Gerard (Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires). Mar 1970. 35p. (In French). Dep. CFSTI (U. S. Sales Only).

About 110 articles issued from 1955 until this day, and dealing with wholesomeness trials relative to irradiated starchy food and sugars are reviewed. Synthetical diets are tested on higher animals; they generally ensure a normal species growth. Moreover the growth of a particular microorganism, namely Aspergillus Orizae is not reduced by the presence of irradiated starch, up to a 3 Mrad dose. Experiments are performed on higher animals, with potatoes, corn maize or diets containing in particular glucose or starch, treated with pasteurizing or sterilizing doses (≥200 krad). Nutrition experiments on man are also explained. Toxicity studies of irradiated sugars, or of media containing them are achieved on microorganisms or tissue cultures. The results in favor of wholesomeness are separated from those leading to a contrary conclusion. As a comparison, trials concerning various current consumption products (caffein, alcohol ...) are mentioned. Experiments on insects are also considered. (auth) (CEA)

25617 (TID-25288(Vol.1)) CHRONIC ANIMAL FEEDING STUDIES ON RADIATION-PASTEURIZED CLAMS. CHICKEN [FEEDING] EXPERIMENTS. Final Report. Fegley, Harry C.; Edmonds, Russell S. (Affiliated Medical Enterprizes, Princeton, N. J.). 22 Jan 1969. Contract AT(30-1)-3573. 531p. Dep. CFSTI.

Clams were given 400,000 and 800,000 rad doses of ^{60}Co γ radiation and stored in a freezer. Before feeding to chickens they were ground in a meat grinder, cooked in a pressure cooker, and added to basic diet mixtures. Data were obtained for effects on egg production, embryo viability, weight, survival, hematology, and pathology. Results are presented in the form of tables. There was no evidence that either irradiated or unirradiated clams affected egg production, hatchability, fertility, embryo viability, incidence of anomalies, birth weights, 30 day weights, or 30 day survival weights. There was a reduced hemoglobin level in some test groups. The only significant histopathology was the finding of aggregated macrophages in the liver. (H.L.W.)

25618 RADIATION PRESERVATION OF FISH. II. TROUT. Ehlermann, D.; Muenzner, R. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.). Z. Lebensm.-Untersuch. Forsch.; 142: No. 1, 7-12(1970). (In German).

Whole rainbow trout (Trutta iridea W. Gibb.) from a nearby farm were gutted, immediately packed in plastic films impermeable to oxygen and water vapour, irradiated with 10 MeV electrons, and stored under wet ice. Samples were examined for organoleptical, chemical and microbiological quality during five weeks. Shelflife of unirradiated controls was 15 days, a dose of 50 krad prolonged shelflife to 21 days. Doses of 100 and 200 krad caused a certain loss of the typical fine flavor of trout, without substantial further improvement of shelflife. A dose of 400 krad prevented spoilage for over 5 weeks but affected flavor markedly. In comparison with other fish species, trout is particularly sensitive to irradiation. The chances for practical application of the radiation process therefore appear less favorable in this case. (auth)

25619 RADIATION PRESERVATION OF FISH. III. CARP. Ehlermann, D.; Muenzner, R. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.). Z. Lebensm.-Untersuch. Forsch.; 142: No. 1, 12-17(1970). (In German).

Freshly slaughtered whole carp (Cyprinus carpio L.) were gutted, immediately packed in plastic film impermeable to oxygen and water vapor, irradiated with 10 MeV electrons, and stored under wet ice. Samples were examined for sensorical, chemical and microbiological quality during 5 weeks. Shelf-life of unirradiated controls was 15 days, a dose of 0.5 Mrad prolonged shelf-life, to about 35 days. Lower doses caused correspondingly shorter shelf-life, higher doses up to 1.5 Mrad only reduced bacterial counts further, but additional shelf-life was not achieved; the optimal dose therefore was 0.5 Mrad. No negative effect of irradiation on flavor of carp was observed; some members of the taste panel consistently rated irradiated samples higher than the nonirradiated. In comparison with other freshwater species, the chances for practical application of the irradiation process to carp seem particularly favorable. (auth)

25620 GAMMA IRRADIATION OF STOMOXYS CALCITRANS. Offori, Evans D. (North Dakota State Univ., Fargo. Dept. of Agriculture, Fargo, N. Dak.). J. Econ. Entomol.; 63: 574-9 (Apr 1970).

Male and female Stomoxys calcitrans (L.) were irradiated as adults 30 ± 6 hours after emergence and as pupae 24 to 18 hours before eclosion. When treated males were mated to untreated virgin females, egg hatch was reduced to less than 1% with a dose of 4 krad applied to pupae and 5 krad to adults. Adults treated with the sterilizing dose of 5 krad did not recover fertility when held for 15 days after treatment. A dose of 2 krad caused 100% sterility in females as measured by egg hatch, and 3 krad were required to stop egg production completely. Sterilized males, whether treated as adults or pupae, were usually fully competitive with untreated males for females. When 4 krad or 5 krad were applied to males or females, no appreciable shortening of lifespan was noticeable when 40 flies were caged together. Treated male adults inseminated females as readily as the control insects; those irradiated as pupae, however, did not perform as well. Fecundity studies revealed that egg production decreased with dose of irradiation at all age levels tested. (auth)

25621 LEBENSMITTEL-KONSERVIERUNG. (Food Preservation). 3rd European Symposium on Food: Modern Developments in Food Preservation, Bristol, England, April 8-10, 1968. Dechema-Monographien, Band 63, Nr. 1125-1143. Frankfurt am Main; Deutsche Gesellschaft fuer Chemisches Apparatewesen E. V. (1969). 392p. (In German and English). (CONF-680470).

Nineteen papers were presented. Three separate abstracts were prepared. Different methods for food preservation, such as freezing, antibiotics, and heat treatment are discussed in the remaining 16 papers. (H.B.G.)

For abstracts of individual papers see: 25622-25624.

25622 GENERAL INTRODUCTION TO RECENT DEVELOPMENTS IN FOOD PRESERVATION. Ingram, M. (Agricultural Research Council, Bristol, Eng.). Dechema Monogr.; 63: No. 1125-1143, 9-20(1969).

From 3rd European Symposium on Food: Modern Developments in Food Preservation, Bristol, England. See CONF-680470.

Advances in food preservation are mostly improvements in mechanical and engineering technology which, while they make big differences in control of quality and cost of production, do not represent really fundamental advances, the basic principles still being the traditional drying, salting, etc., aimed at control of micro-organisms. Where fundamental improvements on traditional processes have been made, it is most often in details concerned with control of the secondary enzymic and chemical changes. There are however a few processes which, though depending on long-established principles, are so much modified that they can no longer properly be called traditional. There were few developments in food preservation that were really revolutionary, in the sense that they created methods of food preservation resting on a principle entirely different from that of the traditional procedures. They have come from diverse sources, including radiation. (H.B.G.)

25623 PRESENT SITUATION ON THE USE OF IRRADIATION FOR FOOD PRESERVATION. Goresline, Harry E. (FAO/IAEA, Vienna). Dechema Monogr.; 63: No. 1125-1143, 284-98(1969).

From 3rd European Symposium on Food: Modern Developments in Food Preservation, Bristol, England. See CONF-680470.

Research in food irradiation in several countries is reviewed and discussed are the objectives that can be accomplished by certain levels of radiation treatment in controlling food spoilage and deterioration, the extension of market life of fresh products, and the control of pathogens of public health significance. The present status in the treatment of specific food groups and the results that were obtained at certain dose levels are discussed with regard to quality, extension of market life, wholesomeness of the products, consumer reactions to irradiated foods, as well as the control of certain pathogens found in foods. The legislative approach to the control of irradiated food in various countries, the clearances given for human consumption after evaluation of data from animal feeding and other tests for wholesomeness or safety for consumption is discussed. The usefulness of radiation treatment in the control of insects in food products, the elimination of parasites of animal origin from meat and fish, possible uses against viruses carried by products of animal origin and the control of pathogens and parasites that may be present in animal feeds and feed ingredients are also given. A general evaluation of the economic picture for irradiation processes is presented. (auth)

25624 USE OF IRRADIATION PLUS HEAT FOR FOOD PRESERVATION. Handen, Poul-Ivar E. (Danish Meat Research Inst., Roskilde). Dechema Monogr.; 63: No. 1125-1143, 337-45(1969).

From 3rd European Sympsoium on Food: Modern Developments in Food Preservation, Bristol, England. See CONF-680470.

Irradiation as a sole treatment is inadequate for most foods stored at ambient temperature, because a sterilizing dose does not result in complete enzyme inactivation, and a sterilizing dose gives rise to objectionable changes in most foods. Neither does heat sterilization alone always constitute a perfect solution because of a poor heat conductivity in a number of food products. A combination of heat and irradiation, however, appears to offer the best of both methods, a low dose with minimum flavor changes and a mild heat treatment resulting in complete enzyme inactivation and no overcooking. By using an uneven dose distribution it is possible to give maximum dose in the centre of a can and thus partly compensate for the bad distribution of thermal energy. Irradiation sensitizes bacterial spores to a subsequent heat treatment whereas vegetative bacterial cells are sensitized to radiation by heat. A synergistic effect of simultaneous heat and irradiation on vegetative cells is also found. (auth)

25625 CONDITIONING OF FLOUR. Copson, David A. pp 96-7 of Microwave Power Engineering. Vol. 2. /Okress, Ernest C. (ed.). New York; Academic Press Inc. (1968).

The use of microwaves for processing wheat flour used for thickening, certain baking, and adhesives for paper is reported. Water absorption and binding properties of flour proteins were increased resulting in high viscosities of the products. Microwave treatment was found to be effective for the deinfestation of stored flour and cereals. Tribolium confusum, grain borers, granary weevils, and rice weevils were killed by exposure to microwaves. The estimated cost for treatment in a 400 bushel/hr treatment plant is 3.5 cents/bushel. (C.H.)

25626 STERILIZATION. Decareau, Robert V. pp 98-100 of Microwave Power Engineering. Vol. 2. /Okress, Ernest C. (ed.). New York; Academic Press Inc. (1968).

Results are reviewed from preliminary studies on the lethal effects of thermal radiation on Clostridium botulinum and yeasts. The possibilities of using microwave energy to reduce the processing time for foods in transparent containers are discussed. It is pointed out that the shorter processing time would improve product quality. Small containers can function as their own pressure cookers, but the internal pressure developed in larger glass containers would necessitate the use of a pressurized system and controlled cooling. The economic feasibility of using microwave energy in processing foods of various densities is discussed. (C.H.)

25627 DESTRUCTION OF DRY ROT FUNGUS IN WOOD AND BRICK. Watson, Alexander (Ministry of Public Building and Works, Watford, Eng.). pp 101-4 of Microwave Power Engineering. Vol. 2. /Okress, Ernest C. (ed.). New York; Academic Press Inc. (1968).

Applications of microwaves for the sterilization of the dry rot fungus, Merulicus lacrymans, in wood and brick walls of buildings are reported. The equipment and method used are described. (C.H.)

25628 DESTRUCTION OF WOODWORM IN TIMBER. Watson, Alexander (Ministry of Public Building and Works, Watford, Eng.). pp 105-7 of Microwave Power Engineering. Vol. 2. /Okress, Ernest C. (ed.). New York; Academic Press Inc. (1968).

Preliminary studies on the use of microwaves for the sterilization of the woodworm, Anobium punctatum, in wood beams and timber are reported. Possible applications in the eradication of woodworms from buildings are discussed. (C.H.)

25629 PRESERVATION OF FOOD PRODUCTS BY IRRADIATION. Saint-Lebe, L.; Berger, G. (CEN, Cadarache, France). Bull. Inform. Sci. Tech. (Paris); No. 141, 77-84(Oct 1969). (In French).

The research carried out in France since 1964 on the preservation of food products by irradiation is classified arbitrarily under three headings: general studies, fundamental research and development research. The first sums up technical and economic notes on irradiation while the other two report most of the experimental results. The fundamental section features the specialization of certain teams in the study of the effects of gamma radiation on vitamins, sugars and starch, or in micro-organism radio-sensitizer research. Development research, centered mainly on potatoes, maize and starch, should follow a trend towards joint efforts. (auth)

25630 RADIATIONS AND NUCLEAR TRACERS IN AGRICULTURAL ETOMOLOGY. Feron, M.; Buscarlet, L. A. (Centre de Recherches Agronomiques du Sud-Est, Montfavet, France). Bull. Inform. Sci. Tech. (Paris); No. 141, 55-62(Oct 1969). (In French).

The sterilizing action of radiations on insects was used for the first time in the U.S.A. to eliminate a dipterous species harmful to cattle. Numerous studies aimed at the application of this technique have since been undertaken throughout the world. Research in France is directed towards the control of corn insects, disease-carrying mosquitoes and insects harmful to crops. The use of radioisotope labeling in entomology is largely restricted to research on the social insects. The development of this research over the last 5 years has been governed by the desire to enlarge on the acquired facts concerning the biology of the hymnoptera for reasons often aimed at the protection of useful insects. The utilitarian aspect also dominated certain studies carried out abroad and directed towards the control of harmful species. (auth)

METALS, CERAMICS, AND OTHER MATERIALS

Metals and Alloys

Refer also to abstracts 25076, 25077, 26033, 26848, and 26849.

25631 (ANL-7417) METALLURGY DIVISION ANNUAL PROGRESS REPORT FOR 1967. (Argonne National Lab., Ill.). Contract W-31-109-eng-38. 141p. Dep. CFSTI.

Research progress is reported in 14 sections. A separate abstract was prepared for each section. (J.R.D.)

For abstracts of individual sections see: 25229, 25632, 25633, 25637, 25638, 25673–25675, 25724, 25725, 25749, 25750, 25767, and 25768.

25632 (ANL-7417, pp 3-22) FAST-REACTOR FUEL-ELEMENT DEVELOPMENT AND FABRICATION. (Argonne National Lab., Ill.).

Research and development are summarized on fast reactor fuel, fast reactor fuel cladding, zero-power fuels, and EBR-II fuels. (J.R.D.)

25633 (ANL-7417, pp 105-10) STRUCTURES OF LIQUID AND SOLID METALS. (Argonne National Lab., Ill.).

Research results are reported on the structure of intermetallic compounds, manganese silicide, deuterated potassium ferrocyanide, hydrogen bonding in organic uranium compounds, hydrates, and binary liquids; neutron monochromator studies of metals; and neutron diffraction studies. (J.R.D.)

25634 (NASA-SP-5057, pp 221-57) ENGINEERING MECHANICS AND MATERIALS. Ault, G. Mervin.

Results of research are reviewed on performance of materials in long-term service, prediction of long-term properties, mechanics of metallurgical embrittlement, materials fatigue, brittle fracture of metals, dispersion-strengthened materials, and composite materials using fibers. (J.R.D.)

25635 METALLURGY THEORY AND PRACTICE. Allen, Dell K. Chicago: American Technical Society (1969). 670p.

Discussions and information are presented concerning metallurgical principles as they are applied to design, selection, heat treating, and processing of metals and alloys. Chapters are included on properties of metals, materials testing, metallurgy methods, constitution of alloys, Fe–C diagrams, treatments for steel, light metals and alloys, Cu and Ni alloys, properties of Pb, Sn, and Zn, specialty metals, powder metallurgy, welding, and machining. (J.R.D.)

Corrosion and Erosion

Refer also to abstract 25763.

25636 (AD-700948) ROLE OF RARE EARTH ADDITIONS IN THE PHENOMENON OF HOT CORROSION. Final Report, February 1, 1968–January 31, 1970. Seybolt, Alan U. (General Electric Co., Schenectady, N. Y. Research and Development Center). Dec 1969. Contract N00014-68-C-0362. 27p. (S-70-1001). CFSTI.

The severity of attack in the hot corrosion of nickel-base superalloys is greatly reduced in alloys containing a dispersoid of CeO_2 or La_2O_3. These oxides interact with the sulfur entering the alloy from Na_2SO_4 decomposition, by forming an oxysulfide of the type M_2O_2S. In this way less Ni_3S_2 is formed, and hence less catastrophic oxidation. (auth) (USGRDR)

25637 (ANL-7417, pp 39-40) CORROSION-RESISTANCE OF CLADDING AND STRUCTURAL MATERIALS. (Argonne National Lab., Ill.).

Research on corrosion by liquid metals is reported. Information is included on dissolution kinetics of solid metals in liquid metals, corrosion inhibition of liquid sodium, and corrosive effects of lithium at high temperatures. (J.R.D.)

25638 (ANL-7417, pp 79-83) SURFACE PHENOMENA. (Argonne National Lab., Ill.).

Research progress is reported on electrochemical processes in oxidation, aqueous corrosion of Al 1100, low-pressure oxidation and growth morphology, and spectral line shifts in electron probe microanalysis. (J.R.D.)

25639 (DP-1089) MECHANISM FOR STRESS CORROSION CRACKING OF STAINLESS STEEL IN REACTOR SYSTEMS. Ondrejcin, R. S. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Dec 1969. Contract AT(07-2)-1. 25p. Dep. CFSTI.

A mechanism for chloride stress corrosion cracking of Type 304 stainless steel that has been sensitized, pickled, and dry ground was shown to involve the chloride-bearing alumina present in the moderator-coolant system of Savannah River reactors. Chloride is absorbed by the alumina during its formation on hot fuel cladding; iron, an impurity in the cladding, greatly enhances chloride absorption. Alumina spalls and is transported by the coolant to the stainless steel surfaces. Chloride is released from the alumina by the acidic reaction at anodic sites on the steel. The negative chloride ion is attracted to the positive anodic site and initiates stress corrosion cracking. Cracking of susceptible stainless steel by this mechanism can be reduced by controlling coolant pH (pD) between 5.0 and 5.2 to prevent general release of chloride, and by avoiding addition of chlorides and chlorinated hydrocarbons to the reactor, and by blocking anodic sites by inhibitors or by changing the potential of the stainless steel. (auth)

25640 (MSAR-70-38) THE EFFECTS OF HIGH TEMPERATURE SODIUM AND HELIUM ENVIRONMENTS ON THE DESIGN PROPERTIES OF 304 AND 316 STAINLESS STEELS. Topical Report No. 18. Kirschler, L. H.; Hiltz, R. H.; Andrews, R. C. (MSA Research Corp., Evans City, Pa.). Mar 1970. Contract AT(11-1)-765. 59p. (XAC-720264). Dep. CFSTI.

As primary candidates for cladding and structural alloys for LMFBR systems, Types 304 and 316 stainless-steel alloys were exposed and evaluated in related high temperature environments. The exposure excursions were helium, high oxygen–sodium and high carbon–sodium. The evaluated properties were tensile tests in air and creep-rupture tests in clean sodium. The tensile tests were at room temperature, at 1200 and at 1400°F. The creep-rupture tests were in clean dynamic sodium at 1200°F with 20 feet/second velocity and a system ΔT. Tensile-test comparisons are made with United States Steel data as well as ASME allowable stresses. Creep-rupture properties are also compared with U.S.S. and ASME allowables. Relatively short-time data are extrapolated to 100,000 hours and these, along with post-test metallographical studies, are compared by means of charts. (auth)

25641 (NMAB-263) HIGH TEMPERATURE OXIDATION RESISTANT COATINGS. Summary Report. (National Military Advisory Board (NRC), Washington, D. C.). Feb 1970. Contract NSR-09-012-910. 54p. CFSTI.

Coatings for superalloys, refractory metals, and graphite are described from the points of view of fundamental principles, specific substrate, and application. This report constitutes a summary of a larger volume which describes these areas in detail. General and specific conclusions were reached, followed by recommendations for upgrading coating capabilities. (auth)

25642 METHODS FOR INVESTIGATING REACTOR MATERIALS AFTER CORROSION IN SUPERHEATED STEAM IN TEST CIRCUITS AND NUCLEAR REACTORS. Leistikow, S. Werkst. Korros., 19: 938-43(Nov. 1968). (In German).

Sheets of Incoloy 800 were exposed to superheated steam at 621°C, 70 atm pressure, and steam velocities of 6.1 m/sec. Quantitative analysis of corrosion must consider the metal–boundary-layer–oxide system. Experimental findings agreed with theoretical calculations of a fixed oxide component, 28% of which was lost in the superheated steam system. Two independent methods were used to study the effects of superheated steam on the corrosion of Incoloy 800 fuel element cladding during longterm insertion in the EVESR Mark III reactor. In spite of exposure to neutron flux and various operational changes, corrosion caused by superheated steam did not significantly exceed values obtained outside the reactor. (H.B.G.)

25643 MECHANISM OF CORROSION OF COLUMBIUM IN SODIUM HYDROXIDE. Leavenworth, H. W. Jr.; Carter, J. P.; Schlain, David (Bureau of Mines, College Park, Md.). Corrosion; 26: 43-50(Feb 1970).

A mechanism for the corrosion of niobium in sodium hydroxide is proposed. Corrosion proceeded by the nucleation and growth of $Na_8Nb_6O_{19} \cdot 13\ H_2O$, having an orthorhombic structure. Weight change vs time behavior was found to be linear, logarithmic, or stifling and the process either concentration or activation controlled depending upon experimental conditions. When activation controlled, the rate controlling step was the conductance of niobium ions through the oxide lattice and the activation energy for the process was 34.8 kcal/mole. When concentration controlled, formation of the corrosion product was controlled by diffusion of hydroxide ions to the sodium niobate crystals. For both mechanisms, growth occurred at the oxide/solution interface. (auth)

25644 CORROSION RESISTANCE OF CAST SECONDARY TITANIUM IN SOME INORGANIC MEDIA. Shapovalova, O. M.; Kuleshova, A. V. Sb. Tr., Vses. Nauch.-Issled. Proekt. Inst. Titana; No. 3, 195-206(1969). (In Russian).

Data are given for the corrosion resistance of secondary Ti obtained from the waste sponge Ti and from 100% turnings or chippings of the Ti–Al–V and Ti–Al–Mo systems. Weight-loss tests were made at room temperature in solutions of inorganic chlorides, HCl (0.5 to 7.0%), and H_2SO_4 (5 to 70%) and in solutions from chemical plants. Secondary Ti is shown to have a high corrosion resistance. (Referativnyi Zh.)

25645 CORROSION OF SECONDARY TITANIUM IN SOLUTIONS OF NITRIC ACID AND IN CERTAIN ORGANIC MEDIA AND ALKALIS. Shapovalova, O. M.; Kuleshova, A. V. Sb. Tr., Vses. Nauch.-Issled. Proekt. Inst. Titana; No. 3, 185-94 (1969). (In Russian).

The corrosion resistance of secondary unalloyed Ti and of Ti–Al–V and Ti–Al–Mo alloys was studied at 10 to 70°C in solutions of HNO_3, oxalic acid, acetic anhydride, formic acid, carbon tetrachloride, and in 10 to 20% NaOH at room temperature. The corrosion resistance was similar to that of technical Ti and therefore secondary Ti can be recommended for use in analogous industrial media. (Referativnyi Zh.)

25646 HIGH-TEMPERATURE OXIDATION OF ALLOYS. Wood, Graham C. (Univ. of Manchester, Eng.). Oxidation Metals; 2: 11-57(Spring 1970).

Developments in the understanding of the oxidation of alloys at elevated temperatures are reviewed, with special reference to binary and ternary alloys upon which many commercial materials are based. Following an initial classification of alloy systems, certain basic principles and their limitations are considered, including factors determining whether an alloy displays surface scaling only, internal oxidation only, or both phenomena; the mode of distribution of cations in an oxide solid solution growing on an alloy; and doping and the Wagner–Hauffe rules. Previous alloy oxidation theory has concerned itself principally with steady-state oxidation but, in practice, behavior of the oxidizing sample in approaching the steady state, both upon initial exposure to the environment and after scale spalling induced isothermally or during thermal cycling, is often as important. Such behavior is illustrated in terms of scale establishment and with respect to compositional changes in the subjacent alloy, the importance of certain alloy and oxide properties being emphasized. After further brief consideration of steady-state scaling, the causes and consequences of breakaway oxidation are presented. The role of major and minor concentrations of third elements on scaling behavior is discussed. A brief reference to situations not considered in detail and with aspects requiring further study is included. (auth)

25647 LOW-TEMPERATURE OXIDATION. Fehlner, F. P. (Corning Glass Works, N. Y.); Mott, N. F. Oxidation Metals; 2: 59-99(Spring 1970).

Low-temperature oxidation is a reaction, occurring at or below room temperature, between a solid and a gas. It usually involves the combination of oxygen with metals, and it has the greatest commercial impact in the presence of moisture, as in corrosion. Cabrera and Mott put forward a theory of low-temperature oxidation, based on the assumption that cation migration occurs under the influence of a potential built up across the growing oxide film. Recent experimental results require that this theory be expanded to explain recent observations such as anion migration during oxide growth and the transition from the initial chemisorbed monolayer to a bulk, three-dimensional oxide. Additional ideas discussed may be summarized as follows. Low-temperature oxidation is controlled by the nature of the oxide; whether it is a network former or a modifier. A period of fast, linear oxidation is followed by a slow logarithmic reaction whose rate, in turn, can increase if the oxide film crystallizes to form grain boundaries. The initial fast oxidation is a continuation of the chemisorption process. Place exchange (anions and cations interchanging positions) occurs when the energy due to the image force of an oxygen ion is greater than the bond energy holding the ion in place. A stable film forms when this bond energy is greater than the image force energy. The oxygen ions formed on the oxide surface then set up a potential across the film. This potential provides the driving force for continued reaction. Oxide growth during this later stage is a slow, logarithmic process. A barrier to ion transport exists at the gas-oxide interface in the case of anion migration and at the metal-oxide interface in the case of cation migration. In both cases, the field built up across the oxide lowers the barrier sufficiently so that ion migration can occur. Network modifiers allow cation migration. The reaction rate is sensitive to crystallographic orientation of the metal, but not to oxygen pressure. A constant voltage is maintained across the film, so that the Cabrera Mott theory explains the logarithmic kinetics. Network-forming oxides allow anion migration. The number of anions, and hence, the rate of reaction, is sensitive to oxygen pressure, but not crystallographic orientation of the metal substrate. Since the potential is a result of the mobile anions, the film tends to grow under constant field. The logarithmic kinetics then must be explained by an increasing activation energy for ion transport, as proposed by Eley and Wilkinson. The logarithmic growth rate can be increased by the presence of water vapor if the water introduces dangling bonds into an oxide network structure. Crystallization of the oxide film also increases its rate of growth and results in the formation of oxide islands. (auth)

25648 A METHOD FOR THE PRODUCTION OF A CERAMIC COATING AND THE RESULTING COATINGS. Bourasse, Andre; Elston, Jean; Meneret, Jean (to Commissariat a l'Energie Atomique). British Patent 1,189,838. 29 Apr 1970. Priority date 31 Aug 1966, France.

A method for deposition of ceramic coatings on metals to prevent diffusion of hydrogen is described. The coating consists of at least two successive layers of glaze composed of at least one alkali metal, at least one alkaline-earth-metal oxide, silica, alumina, and zirconium oxide. Chromium oxide may also be used. The coating layers are baked at 1250 and 1350°C. (J.R.D.)

25649 A STUDY OF CHARGE TRANSPORT PROCESSES DURING THE OXIDATION OF ZIRCONIUM ALLOYS. Shirvington, P. J.; Cox, B. (Atomic Energy of Canada Ltd., Chalk River, Ont.). J. Nucl. Mater.; 35: 211-22(May 1970).

It was confirmed that the oxidation of crystal-bar zirconium was limited by electron transport through the oxide and across the outer oxide surface between electronic flaws in the oxide and the sites of oxygen reduction. Two thirds of the total resistance was due to the surface resistance. Electronic conduction did not appear to be a limiting factor in the oxidation of Zircaloy-2 or of zirconium-rich binary alloys with chromium, iron, tin, and nickel. A decrease in the oxidation rate of these alloys on short circuiting the electronic current could not be explained on the basis of either simple charge transport processes or the small morphological changes caused by changes in the field across the oxide. A hypothesis based on space-charge accumulation at a p-n junction near the outer oxide surface was proposed. An explanation of differences in the early pre-transition kinetics of electropolished and pickled Zircaloy-2 was proposed on the basis of the above hypothesis. (auth)

Preparation and Fabrication

Refer also to abstracts 25174, 25178, 25179, 25236, 25683, and 25711.

25650 (BNWL–1331) EVALUATION OF WELD JOINT DESIGNS BETWEEN WIRE WRAP AND END CAP. Myers, R. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr 1970. Contract AT(45-1)-1830. 10p. Dep. CFSTI.

A preliminary study of potential problems associated with five different wire to end cap joint designs was conducted. The designs included a 45° hole, 90° hole, 45° groove, small and large tangent welds. Tensile test results indicated sufficient strength can be attained by using any of the five joint designs. Fabrication techniques pose various problems that are minimal with the 90° hole and small tangent weld designs. (auth)

25651 (BNWL–1332) EVALUATION OF 3/32 IN. FILLET WIRE-END CAP WELD. Myers, R. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr 1970. Contract AT(45-1)-1830. 20p. Dep. CFSTI.

A study of the 3/32 in. fillet wire-end cap weld was made to determine the characteristics of this welding technique. The test samples were similar to actual wire-end cap welds used on fuel pins. The welding parameters were controlled and recorded. A visual examination revealed only minor dimensional variations in the length of the weld. Radiography showed that 3 of the 22 welds lacked penetration. When tensile tested, strength of the welds was found to be inversely proportional to the amount of penetration. All samples fractured on the wire side of the welds. Good resistance to corrosion was demonstrated in oxalic acid etch tests. Metallography confirmed previous radiography results and revealed that the amount of necking in the wire next to the weld increased as penetration increased. (auth)

25652 (GEMP–727) PHYSICAL AND MECHANICAL PROPERTIES OF REACTOR MATERIALS. Final Progress Report. Conway, J. B.; Flagella, P. N. (General Electric Co., Cincinnati, Ohio. Nuclear Systems Programs). Dec 1969. 67p. Dep. CFSTI.

The physical and mechanical properties of materials being considered for high-temperature reactor applications are summarized. Emphasis is placed on the creep-strain profile of Types 304 and 316 stainless steel. (J.R.D.)

25653 (NP-tr-1889) SECTION PREPARATION OF MOLYBDENUM ALLOYS ON A VIBRATORY POLISHER. Gessner, L.; Otto, B.; Chakraborty, A. Translated for Australian Atomic Energy Commission Research Establishment, Lucas Heights, from Prakt. Metallog.; 1: 79-80(1964). 2p. Dep. CFSTI (U. S. Sales Only).

Working directions are provided for preparing sections of Mo-Fe; Mo-Al; Mo-Co and Mo-Ni, on a vibratory polisher. (Australia)

25654 (RPI-3719-7) PRECIPITATION AND DISPERSION HARDENING IN MAGNESIUM BASE ALLOYS. Annual Report. Stoloff, Norman S. (Rensselaer Polytechnic Inst., Troy, N. Y.). 1 Mar 1970. Contract AT(30-1)-3719. 20p. Dep. CFSTI.

During the report period, work on the Mg-Th-Zr alloy was extended to study the role of thermomechanical processing on particle distribution and mechanical properties. In addition, considerable effort was devoted to a new program to study deformation and fracture modes in hafnium. It was found that slip in hafnium occurs primarily on $\{10\bar{1}0\}$ prism planes, with basal slip a secondary mode at 298°K. Twinning occurs primarily on $\{10\bar{1}2\}$ planes at 298°K with $\{11\bar{2}1\}$ as the predominant mode at 77°K. $\{10\bar{1}2\}$ twins are broad and lenticular while $\{11\bar{2}1\}$ twins are narrow and parallel sided. Fracture at room temperature appeared to nucleate in the form of voids at grain boundary triple points. Fracture at 77°K was predominantly transcrystalline, along an as yet unidentified cleavage plane. Fine microcracks also were observed along twin-matrix boundaries. Hydriding hafnium leads to significant increases in yield strength at 25°C, but is accompanied by a sharp drop in ductility. Nevertheless over 25% elongation is observed in hydrided samples. An electrothinning technique for hafnium has been developed. Thermal-mechanical treatments show promise for increasing the strength of Mg-Th-Zr alloy HK31A. (auth)

25655 (UCRL-71668) CVD TUNGSTEN AND TUNGSTEN-RHENIUM ALLOYS FOR STRUCTURAL APPLICATIONS. PART III. RECENT DEVELOPMENTS. Huegel, Frank J.; Holman, William R. (California Univ., Livermore. Lawrence Radiation Lab.). 12 Dec 1969. 22p. (CONF-700510-1). Dep. CFSTI.

From 2nd International Conference on Chemical Vapor Deposition, Los Angeles, Calif.

Results obtained in a continuing program to develop CVD tungsten and tungsten-rhenium alloy structures with mechanical properties comparable to those of wrought products are presented. Data relating the effects of all the plating parameters on the deposition rate, deposit composition, topography, microstructure, and mechanical properties, together with effects of various heat treatments on the microstructure and properties, are reviewed. Developments in CVD equipment and techniques are also included. (auth)

25656 WELDING SMALL TUNGSTEN WIRES TO MOLYBDENUM ROD. Caryle, David C. (Univ. of Texas, Austin). Rev. Sci. Instrum.; 41: 599-600(Apr 1970).

A method for welding small tungsten filament wires to molybdenum support rods is briefly described. A 0.381 mm tungsten wire was spot welded to a 3.175 mm molybdenum support rod by placing a 0.0127 mm thick piece of tantalum foil between the tungsten wire and the molybdenum support. The welding area was flooded with argon during the welding. Cleaning procedures are described. (W.H.K.)

25657 STRENGTHENING OF COPPER WITH TANTALUM (CONTINUOUS) FILAMENTS. Ahmad, Iqbal; Barranco, J. M. (Army Watervliet Arsenal, N. Y.). Met. Trans.; 1: 989-95 (Apr 1970).

Composites of copper reinforced with 0.003 in. dia continuous tantalum filaments were fabricated up to 0.38 volume fraction using the infiltration technique. Their elastic modulus, ultimate tensile strength, and yield strength were found to be linear functions of the volume fraction of the filaments (V_f). The filaments elongated continuously until fracture occurred at the ultimate tensile strength of the composite given by $S_c = S_f V_f + \sigma_m^{\prime\prime}(1-V_f)$ where $\sigma_m^{\prime\prime}$ is the flow stress of the matrix at the fracture strain of the composite and S_f is the ultimate tensile strength of the filament. It was shown that the tensile strength of not only Ta-Cu but other ductile filament-ductile matrix systems can also be closely predicted. (auth)

25658 ELECTRON AND ION BEAM SCIENCE AND TECHNOLOGY. VOLUME 1. Proceedings of the Second International Conference, New York, April 1966. Bakish, Robert (ed.). Metallurgical Society Conferences, Volume 51. New York; American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc. (1969). 646p. (CONF-660414-(Vol.1)).

Thirty papers are presented in this volume under the following headings: Physics of Electron and Ion Beams, Electron Beams in Melting and Refining (Basic and Industrial), and Electron Beam Welding. (D.L.C.)

25659 SOME DEVELOPMENTS IN THE END CLOSURE WELDING TECHNOLOGY FOR ZIRCALOY CLADDED FUEL RODS. Amato, I.; Carena, G. (FIAT, Turin). Energ. Nucl. (Milan); 17: 234-43(Apr 1970).

The process generally and widely used for the end closure welding of Zircaloy 2 and 4 cladded fuel rods is the tungsten inert gas welding (TIG). When massive end plugs were used, the formation of a shrinkage defect due to unbalanced cooling rate between tube wall and end plug was observed. Through a good choice of the welding variables, such as current, gas flow, peripheral rotation velocity, it was demonstrated that it was possible to eliminate the shrinkage defects. In order to achieve welding joints without contamination, the welding process was carried out holding the welding end closure in a chamber backfilled with inert gas; so, it was possible to obtain welded joints that had a corrosion behavior in pressurized water not different with respect to the starting material: in addition no hydrogen pick-up was observed both after the welding process and after the corrosion test. The micrographic aspect of the welded joint showed a weld penetration deeper than the wall tube thickness, such penetration is acceptable for fuel end closure weld joint. (auth)

25660 LEVITATION-MELTING AND AMERICIUM-REDUCTION TECHNIQUES FOR PREPARATION OF THORIUM-AMERICIUM ALLOYS. Adair, H. L. (Oak Ridge National Lab., Tenn.). J. Inorg. Nucl. Chem.; 32: 1173-81(Apr 1970).

Levitation melting as a technique for melting metallic materials was proposed in 1923 but has not been widely applied for small quantities of material, because it is time-consuming and somewhat complicated. For the thorium-americium alloys described, for use as Moessbauer sources, it offered advantages over the more conventional methods, such as arc melting. The problem of crucible contamination was eliminated, and the alloy was more homogeneous. (auth) (UK)

25661 INDUSTRY COOPERATIVE PROGRAM ON HEAVY-SECTION STEELS. Chockie, L. J. (General Electric Co., San Jose, Calif.); Larson, C. F. pp 1005-16 of Pressure Vessel Technology. Pt. II. New York; American Society of Mechanical Engineers (1969).

From 1st International Conference on Pressure Vessel Technology, Delft, Netherlands. See CONF-690906(Pt.2).

The background and current status of the "Industry-Cooperative Program on Heavy-Section Steels," which is being carried out under the auspices of the Pressure Vessel Research Committee of the Welding Research Council by the leading companies involved in the design and fabrication of pressure vessels for nuclear reactors are reviewed. The objective of the program is to determine the mechanical properties of heavy-section steel plates, weldments, forgings and castings, and to determine how effective the inspection techniques are in locating discontinuities in such components. Test specimens are being obtained from actual production plates for nuclear contracts by utilizing nozzle cutouts, crop ends, and extra material ordered especially for this work. Also included is a comprehensive study of in-service inspection techniques. A number of task groups have been organized to guide the work. The program complements the HSST program being sponsored by the U. S. Atomic Energy Commission. (auth)

25662 WELDING OF TITANIUM, ZIRCONIUM, AND TANTALUM. Gramach, M. Aust. Weld. J.; 14: 33-4(Mar 1970).

A brief review is given of welding techniques such as electron beam and plasma-arc welding applied particularly to titanium. (Australia)

25663 IMPROVEMENTS IN RADIOACTIVE PRODUCTS. (to Nuclear Radiation Developments, Inc.). British Patent 1,187,158. 8 Apr 1970. Priority date 19 Jul 1967, United States.

A plating method is described for use on radioactive cores. The protective metal is electrodeposited over the exposed surface to guard against abrasion, corrosion, oxidation, and other forms of chemical or physical attack. Gold alloyed with 0.10 to 25.0 percent by weight of cadmium, cobalt, copper, nickel, or silver is used. (J.C.W.)

25664 HAFNIUM ALLOY. Mock, James W.; Nigon, John F. (to U. S. Atomic Energy Commission). U. S. Patent 3,505,064. 7 Apr 1970. Filed 21 Oct 1965.

Hafnium alloys having unusually high oxidation resistance and strength at elevated temperatures are described. The alloys are composed of 0 to 100 to 600 ppM oxygen, 200 to 500 ppM iron, 20 to 200 ppM titanium, 200 to 500 ppM nickel, up to about 4.5% by wt Zr and the balance of Hf. The Fe content improves corrosion resistance, while Ti and Ni are added to improve fabricability and weldability. (J.R.D.)

25665 PROCEEDINGS OF SECOND ANNUAL TECHNICAL MEETING, INTERNATIONAL METALLOGRAPHIC SOCIETY, INC., SEPTEMBER 8–10, 1969, SAN FRANCISCO, CALIFORNIA. Bender, J. H.; Johnson, K. A. (eds.). Los Alamos, N. Mex.; International Metallographic Society, Inc. (1970). 364p. (CONF-690920).

Thirty-five articles are included; separate abstracts were prepared for 11. Four articles on remote metallography facility at Lawrence Radiation Laboratory, low speed diamond saw, improvements in hot microhardness testing at 1500°C, and applications of a photomicroscopic technique to the particle size analysis of a sample from a nuclear cratering cloud were previously included in NSA as 24: 351; 24: 2342; 23: 51032; and 23: 49952, respectively. The remaining 20 articles contain information on low-carbon iron, stainless steel etching, Fe–Ni alloy, lead telluride, Ni–Mo–Cr alloys, Fe alloys, Cr–Mo steels, austenitic stainless steels, Fe–Ni–N alloys, Fe–Ni meteorite, polycarbonate, determination of crystallographic textures, quantimet area measurement problems, operation and modification of deep field microscope, metallography studies with secondary ion emission microanalyzer, theory and applications of solder joint fractography, and variations in Al thin film properties with changes in evaporation parameters. (P.C.H.)

For abstracts of individual papers see: 25001, 25194, 25195, 25666–25668, 25717, 25718, 25742, 25743, and 25801.

25666 ELECTROLYTIC POLISHING AND ETCHING OF THIN FOILS. Arrowsmith, H. W.; Rencken, D. G. (Pacific-Northwest, Richland, Wash.). pp 21–7 of Proceedings of Second Annual Technical Meeting, International Metallographic Society, Inc., September 8–10, 1969, San Francisco, California. /Bender, J. H. (ed.). Los Alamos, N. Mex.; International Metallographic Society, Inc. (1970).

See CONF-690920.

A technique was developed which permitted the electrolytic polishing and etching of the edge of thin foils utilizing an optical electrolytic etching cell. Foils having thicknesses ranging from 12 to 250 microns were successfully etched with excellent edge retention. Procedures are enumerated for sample preparation, electrolytic polishing, and electrolytic etching of α-Pu, Cu, Cu–Ta, and stainless steel. Using the new electrolytic etching equipment, mechanical polishing procedures can be evaluated by observing the electrolytic removal of the flow metal from the surface caused by mechanical polishing. Photomicrographs are included, which demonstrate the capability of the new equipment and techniques. (auth)

25667 A NOTE ON THE METALLOGRAPHIC PREPARATION OF U–Pu–Zr ALLOYS. Bender, J. H. (Los Alamos Scientific Lab., N. Mex.). pp 29–32 of Proceedings of Second Annual Technical Meeting, International Metallographic Society, Inc., September 8–10, 1969, San Francisco, California. /Bender, J. H. (ed.). Los Alamos, N. Mex.; International Metallographic Society, Inc. (1970).

See CONF-690920.

A technique for the metallographic preparation of U–Pu–Zr alloys is described, including a comparison of two electrolytic etches that permit an estimate of oxygen content in the alloy. Samples of known oxygen content, fabricated by two methods, were prepared and examined. (auth)

25668 ALTERNATING CURRENT ELECTRO-POLISHING AND ELECTRO-ETCHING OF METALS. Johnson, K. Allan (Los Alamos Scientific Lab., N. Mex.). pp 145–61 of Proceedings of Second Annual Technical Meeting, International Metallographic Society, Inc., September 8–10, 1969, San Francisco, California. /Bender, J. H. (ed.). Los Alamos, N. Mex.; International Metallographic Society, Inc. (1970).

See CONF-690920.

Alternating current electro-polishing and electro-etching of metals and alloys is demonstrated as a broadly applicable technique. As in dc electrolytic etching and polishing, different metals and alloys require different cell conditions and electrolytes. (auth)

25669 CONTRIBUTION TO THE BEHAVIOR OF NITROGEN AT ELECTRON BEAM MELTING OF VANADIUM, AND TO THE DETERMINATION OF NITROGEN. Gottwald, H. J.; Krone, K.; Krueger, J. (Rheinisch-Westfaelische Technische Hochschule, Aachen). Metall; 23: 1284–9(Dec 1969). (In German).

Vanadium melted by electron beams at about 2100°C, was exposed to high vacuum. The dissolved oxygen content decreased, the nitrogen content, however, approached a constant value of 0.3% by weight. If the initial content was below this value, the melted metal took up nitrogen; if the initial value was higher, partial evaporation occurred. Various methods for nitrogen determination were studied; the Pt-capsule method yielded best results. (H.B.G.)

Properties Evaluations

Refer also to abstracts 25176, 25202, 25235, 25238, 25239, 25243, 25654, 26699, 26753, and 26765.

25670 (AD–701114) MECHANICAL-PROPERTY DATA [FOR] 5Al–6Sn–2Zr–1Mo–0.25Si–Ti: AGED FORGING. (Battelle Memorial Inst., Columbus, Ohio). 1969. Contract F33615-69-C-1115. 8p. CFSTI.

5621-S alloy is a new high-temperature titanium alloy. The alloy was developed to meet the need for a titanium material capable of withstanding temperatures as high as 1000°F for long periods. 5621-S contains silicon which enhances high temperature creep strength. This alpha-matrix alloy is reported to have moderate room temperature tensile strength, excellent notch toughness, fatigue and creep strength, hot salt stress corrosion resistance, and thermal stability. It is reported to have greater creep strength than any other commercially available titanium alloy. (auth) (USGRDR)

25671 (AD–701800) MECHANICAL PROPERTIES OF BERYLLIUM. VOLUME I. Report Bibliography, December 1960–November 1968. (Defense Documentation Center, Alexandria, Va.). Feb 1970. 119p. (DDC-TAS-70-9-1). CFSTI.

The annotated bibliography comprises citations of unclassified reports dealing with the properties and metallurgy of beryllium and its applications. The information covers tests for such properties as ductility, hardness, deformation, heat resistance, failure, and fatigue. Applications of beryllium in airframes, brakes, fuel tanks, storage tanks and rocket cases are also discussed. (auth) (USGRDR)

25672 (AI-AEC-12944) BIAXIAL CREEP AND STRESS RUPTURE OF WIRE-WRAPPED CLADDING IN 1200°F SODIUM UNDER ΔT CONDITIONS. Interim Report. Shively, J. H. (Atomics International, Canoga Park, Calif.). 15 Apr 1970. Contract AT(04-3)-701. 44p. Dep. CFSTI.

The results of biaxial stress-rupture and creep data tests on 10 to 15% cold-worked Type 316 stainless steel are presented. The tests were performed at 1200°F, in sodium flowing at 6 ft/sec. A system ΔT of 50°F was induced, just ahead of the test section. The tubes were wrapped with 0.070-in. diameter stainless steel wires with a 12-in. pitch, arranged in a close-packed array and surrounded with a hexagonal stainless steel shroud tube. The purpose of the test was to study the mass transfer effects of flowing sodium, acting in concert with wire spacers, on the biaxial creep behavior of stainless steel cladding. Control tests without wires were made in static sodium. The stress-rupture life of wire-wrapped tubes in flowing sodium falls within the uncertainty band for tests made in static sodium on another lot of larger diameter. Some failures were located under wires near the inlet, which may be explained by interactions of wires and cladding, introduced during attachment of the wires to the tube end caps. The observed wire shortening was related to tube diametral strain. Self-welding of wires to tubes was also observed. These results are only preliminary, pending further examination of the tubes. (auth)

25673 (ANL–7417, pp 51–9) MECHANICAL PROPERTIES. (Argonne National Lab., Ill.).

Research efforts are summarized on fatigue theory, precipitation hardening, Arrhenius equation for plasticity, deformation of hcp metals, and hydrogen behavior in metals. (J.R.D.)

25674 (ANL–7417, pp 61–8) DIFFUSION IN SOLIDS. (Argonne National Lab., Ill.).

Research results are presented on diffusion in Zn, diffusion of Zn in Ag, Cu, and CuZn, impurity diffusion in Al, diffusion of Cu in iron, diffusion in alkali metals, diffusion in Fe, diffusion of sodium in rubidium chloride, diffusion of O in CoO, and defects in nonstoichiometric oxides. (J.R.D.)

25675 (ANL–7417, pp 69–70) ELASTIC PROPERTIES OF METALS AND ALLOYS. (Argonne National Lab., Ill.).

Research results are reported on elastic moduli of bcc Ti and Ti–Cr alloys, and on elastic moduli of rare earths, actinide metals, and actinide alloys. (J.R.D.)

25676 (BNL-50197) INITIAL REACTION OF CARBON MONOXIDE WITH LIQUID SODIUM. Hobdell, M. R.; Newman, L. (Brookhaven National Lab., Upton, N. Y.). Sep 1969. 12p. Dep. CFSTI.

Some preliminary experiments were conducted on the initial reaction of carbon monoxide with liquid sodium to determine if CO or sodium-CO compounds might be sodium soluble. Three distinct reaction stages are described. (G.M.C.)

25677 (D-1-82-928) THE STRUCTURE, MECHANICAL PROPERTIES AND DEFORMATION BEHAVIOR OF Ti-Al AND Ti-Al-X ALLOYS. Williams, J. C. (North American Rockwell Corp., Thousand Oaks, Calif. Science Center); Blackburn, M. J. (Boeing Scientific Research Labs., Seattle, Wash. Solid State Physics Lab.). Sep 1969. 29p.

Strengthening by precipitation of the ordered α_2 phase (based on Ti_3X) has been studied in binary and ternary $Ti-Al-X^3$ (where X = Sn, Ga, In or Pb) alloys. The observed strengthening can be separated into two principal components; one due to the dislocation/ordered particle interaction and the other due to dislocation/precipitate stress field interactions. The former of these appears more important in some cases, e.g., Ti-Al-Sn alloys; whereas the latter appears to predominate in other cases, e.g., Ti-Al-Ga alloys. The brittleness of single phase Ti_3Al is related to slip morphology and the decreased extent of $\langle 11\bar{2}3\rangle$ glide with increasing Al content. The marked improvement in strength and ductility of the $Ti_3(Al_{0.5}Ga_{0.5})$ and $Ti_3(Al_{0.25}Ga_{0.75})$ compounds results from the phase separation into $\alpha_2 + Ti_2Ga$ with an accompanying change in slip morphology and an increase in the extent of $\langle 11\bar{2}3\rangle$ glide. (auth)

25678 (GEMP-732) SHORT-TERM TENSILE AND LOW-CYCLE FATIGUE STUDIES OF INCOLOY 800. Conway, J. B. (General Electric Co., Cincinnati, Ohio. Nuclear Systems Programs). Dec 1969. Contract AT(40-1)-2847. 44p. Dep. CFSTI.

Two grades of Incoloy 800 were tested for short-term and low-cycle fatigue behavior in air. Material was available in the form of mill-annealed bar stock and solution-annealed bar and plate stock. The mill-annealed bar stock (grade 1) was tested at 427, 538, and 593°C. The solution-annealed bar and plate stock (grade 2) was tested at 538, 649, 704, and 760°C. Strain rates of 4×10^{-3} and 4×10^{-4} sec^{-1} were investigated at strain ranges to cover the range of 100 to 100,000 cycles to failure. Results are presented in graphic form. (J.C.W.)

25679 (GEMP-739) ORTC-III IN-REACTOR EXPERIMENT. Baxter, W. G.; Pugh, R. (General Electric Co., Cincinnati, Ohio. Nuclear Systems Programs). Dec 1969. Contract AT(40-1)-2847. 49p. Dep. CFSTI.

The chemical compatibility of W-25Re and Re thermocouple sheath materials in contact with mixed oxide fuel (80% UO_2-20% PuO_2) at 2300°C for a period of 1000 hours was investigated. A mixed oxide fuel capsule was fabricated using 316 SS tubing (¼ in. OD). The fuel pellets were cored (0.065 in. diameter) to allow insertion of a metallic thermocouple sheath. Both W-25Re and Re were evaluated as thermocouple sheath (0.0625 in. OD × 0.007 in. wall) materials in contact with the mixed oxide fuel. A W, W-25Re thermocouple (0.009 in. diameter wires) was fabricated using high purity hafnia as an insulator (0.046 in. diameter, two-0.012 in. diameter holes) to measure centerline fuel temperatures. The fuel capsule was designed to operate at 2300°C centerline temperature. The fission heat was dissipated through the cladding into liquid sodium, through a 5 mil helium gap into circulating water. The test operated 4.5 hours at 2100° to 2275°C with estimated temperatures as high as 2500°C in the lower portions of the fuel. At this time fission fragments were detected in the primary helium cooling stream and the test was terminated. The HfO_2 insulated thermocouple performance was outstanding. It reacted promptly to each reactor power change and was operational after frequent thermal cycles. Posttest examination revealed a transverse break in the W-25Re sheath material. The exact cause of this failure is unknown. No chemical reaction was detected between the mixed oxide fuel and either thermocouple sheath material. (auth)

25680 (GEMP-740) EVALUATION OF PLASTIC FATIGUE PROPERTIES OF HEAT-RESISTANT ALLOYS. Conway, J. B. (General Electric Co., Cincinnati, Ohio. Nuclear Systems Programs). Dec 1969. Contract AT(40-1)-2847. 72p. Dep. CFSTI.

Low-cycle fatigue tests were made on rod stock Types 304, 316, and 348 stainless steels. The parameters affecting low-cycle fatigue life of metals and alloys at elevated temperatures were determined. Low-cycle fatigue data for use in the design of structural components of high-performance nuclear reactor systems are given. Tests were performed on AISI Type 304 stainless steel rolled at 1180°C into 16 mm rods, annealed 1 hr at 1066°C, and water quenched. Sections were cut, straightened, stress relieved 30 min at 1010°C, and water quenched. Ladle chemistry by weight percent of Type 316 was tabulated. Type 348 specimens were given the same sequence of treatments as Type 304. Plastic fatigue properties were evaluated from 21 to 816°C. (J.C.W.)

25681 (NBS-SPEC. PUBL.-315-4) BIBLIOGRAPHY ON THE HIGH TEMPERATURE CHEMISTRY AND PHYSICS OF MATERIALS, OCTOBER, NOVEMBER, DECEMBER 1969. Diamond, J. J. (ed.) (National Bureau of Standards, Washington, D. C. International Union of Pure and Applied Chemistry. Commission on High Temperatures and Refractories). Jan 1970. 85p. GPO $0.75.

References are included on devices for production, measurement, and control of high temperatures. References are also included on high temperature properties of metals, nonmetals, and mixed materials. Other citations are concerned with spectra of high-temperature gases and reactions between gases and condensed phases. (J.R.D.)

25682 (ORNL-TM-2858) TENSILE PROPERTIES OF HASTELLOY N WELDED AFTER IRRADIATION. McCoy, H. E.; Gunkel, R. W.; Slaughter, G. M. (Oak Ridge National Lab., Tenn.). Apr 1970. Contract W-7405-eng-26. 24p. Dep. CFSTI.

Fusion welds affecting 75% of the cross section were made in small tensile samples (0.125 in. in diameter) of Hastelloy N irradiated to thermal fluences up to 9.4×10^{20} neutrons/cm^2. All of the unirradiated samples and 67% of the irradiated samples were satisfactorily welded using a specialized technique developed for this program. Surface contamination was suspected to be the cause of the unsuccessful welds in the irradiated samples. The welded irradiated samples generally had as good tensile properties at 25 and 650°C as the irradiated base metal. The weld metal deformed appreciably at 650°C and made a significant contribution to the overall fracture strain. The fracture location in the irradiated samples tested at 650°C shifted from the weld metal to the base metal following the post-weld anneal of 8 hr at 870°C. The porosity which was observed near the fusion line of the irradiated samples probably results from transmuted helium bubbles, but this did not seem to affect the location of the fracture. (auth)

25683 (SRO-552-3) QUANTITATIVE DETERMINATION OF THE STRUCTURE-PROPERTY RELATIONSHIPS IN NUCLEAR FUEL ELEMENT MATERIALS. Quarterly Progress Report, December 15, 1969-March 15, 1970. Rhines, F. N.; DeHoff, R. T.; Hench, L. L. (Florida Univ., Gainesville. Dept. of Metallurgical and Materials Engineering). Apr 1970. Contract AT-(38-1)-552. 22p. Dep. CFSTI.

Measurements of the variation of gas permeability with porosity and particle size are found to strongly correlate with independent measurements of the genus (connectivity), for a given particle size, but to be proportional to the first power of the particle size. An apparatus for determining thermal conductivity was received, and initial thermal conductivity measurements made. The first creep test of a porous nickel sintering was successfully performed. The first loose stack sinterings of uranium dioxide powder were prepared by sintering in a tungsten wound furnace at 2250°C. A new rationalization of the variation of tensile properties of porous copper compacts was evolved and successfully applied to experimental determinations of these properties. The application required the development of a new technique in quantitative microscopy, involving the determination of extreme values of microstructural properties from measurements made on fracture surfaces. (auth)

25684 (UCRL-Trans-10453) DEFORMATION OF BINARY ALLOYS OF URANIUM CONTAINING 0-20 AT PERCENT Mo, 0-30 AT PERCENT Nb AND 0-100 AT PERCENT Zr WHEN SUBJECTED TO CYCLIC HEATING UP TO 600-900°C. Grigorovich, V. K.; Golovkina, N. E. Translated by A. M. A. Mincer for Univ. of California Lawrence Radiation Lab., Livermore, from pp 28-37 of Fiziko-Khimiya Splavov i Tugoplavkikh Soedinenii s Toriem i Uranom, Izdatel'stvo Nauka, Moscow, 1968. 22p. Dep. CFSTI.

The shape stability and the tendency toward surface hummock formation on cyclic heating has been studied for uranium alloys with molybdenum (up to 20 at. % of Mo), niobium (up to 30 at. % of Nb), and zirconium (up to 100 at. % of Zr). The specimens were subjected to forging and were then quenched from 800°C and annealed for 24 hr at 500°C. It was found that the shape stability of specimens after cyclic heating increases as the content of the alloying additive is raised to 20 to 30 at. %. Near the upper temperature limits of the heating cycles the residual deformations are seen to increase. The shapes of the alloy specimens that undergo an $\alpha \rightarrow \beta$ transformation are changed markedly. The alloys that preserve the γ solid solution having isotropic cubic structure, are more stable to deformation than alloys having the anisotropic α-U structure or undergoing an $\alpha \rightarrow \gamma$ transformation. At equal contents of the alloying additive the U–Mo alloys occupy the foremost position as regards the stability; they are followed by the U–Nb and U–Zr alloys in this order. The binary uranium alloys containing more than 10 at. % of Mo or 15 at. % of Nb proved to be practically stable to cyclic heating with upper temperature limits of 600 to 900°C. In the U–Zr system the alloys containing 60 to 65 at. % of Zr exhibit dimensional stability. The dimensions of specimens of uranium alloyed with 20 to 30 at. % of Zr are reasonably stable under conditions of cyclic heat treatment when the upper temperature limit of the cycles does not exceed 800°C, which is probably due to the greater strength of this alloy. (auth)

25685 CREEP BEHAVIOR OF W–5 Re. Vandervoort, Richard R. (Univ. of California, Livermore). Met. Trans.; 1: 857-64(Apr 1970).

Polycrystalline W–5 wt % Re was creep-tested in tension from 1500 to 1900°C at stresses from 2500 to 10,000 psi in a vacuum of 10^{-8} torr. The steady-state strain rate was directly proportional to stress to the 5.5 power, and the apparent activation energy for creep was 104 kcal per mole. Dislocation substructure that developed during high-temperature deformation was studied by transmission electron microscopy. The total dislocation density was dependent on stress to the 2.1 power and was insensitive to temperature and strain. No subgrains were found in creep tested specimens. The rate-controlling deformation mechanism was ascribed to dislocation climb where the governing diffusion process was dislocation core diffusion. Comparison of creep data for tungsten, W-5 wt % Re, and W-25 wt % Re showed that W-5 wt % Re alloy has significantly better creep properties than the other two materials. (auth)

25686 DYNAMIC STRAIN AGING IN CARBIDE-STRENGTHENED MOLYBDENUM ALLOYS. Raffo, Peter L. (Lewis Research Center, Cleveland). Met. Trans.; 1: 835-41(Apr 1970).

A study was made of the dynamic strain aging processes in carbide strengthened molybdenum alloys. Strengthening due to dynamic strain aging was observed in the temperature range 1500 to 2400°F. The strengthening is believed to arise from the pinning of mobile dislocations by metal-carbon pairs or clusters and/or carbide precipitates. This immobilization of the dislocations led to a high work hardening rate and the observed strengthening. (auth)

25687 A NEW APPROACH TO THE PREDICTION OF LOW-CYCLE FATIGUE DATA. Berling, J. T.; Conway, J. B. (General Electric Co., Cincinnati). Met. Trans.; 1: 805-9(Apr 1970).

Low-cycle fatigue data for annealed AISI Type 304, 316, and 348 stainless steel to 816°C were analyzed and a new relationship was identified associating fatigue data with short-term tensile behavior. A logarithmic plot of plastic strain range vs time to fracture was shown to be linear with a slope of minus unity. This line was also found to originate at the point corresponding to the tensile ductility. A similar analysis for elastic strain range data revealed a relationship with the strain-hardening exponent measured in a short-term tensile test at the same temperature and strain rate. These correlations were combined to provide an equation for predicting the relationship between total strain range and cycles to fracture. This approach was termed the Method of Characteristic Slopes. (auth)

25688 RELATIONSHIP BETWEEN DISCONTINUOUS YIELDING AND CYCLIC BEHAVIOR IN POLYCRYSTALLINE MOLYBDENUM. Beardmore, P.; Thornton, P. H. (Ford Motor Co., Dearborn, Mich.). Met. Trans.; 1: 775-9(Apr 1970).

The fatigue properties of polycrystalline molybdenum at room temperature were determined by axial tension-compression tests in both stress and strain control modes to give lives of up to 10^8 cycles. Under the appropriate conditions, the endurance limit could be considerably reduced, e.g., the stress to cause failure in 10^8 cycles decreased from ~42,000 psi at 5 cps to ~28,000 psi at 0.5 cps. The fatigue resistance as assessed by either strain control or by stress control is discussed in relation to the tensile and creep behavior, and it is concluded that the reduction in the long life fatigue resistance with decrease in the cyclic frequency is due to the time dependent generation of a mobile dislocation population. The previously accepted value of 0.6 for the ratio FL/UTS for bcc metals can be attributed to this frequency effect. A lower value for this ratio, 0.4, can be derived from the high frequency data by the use of an extrapolation technique. This lower value is confirmed by long life, low frequency tests, in agreement with the value for fcc metals. The importance of obtaining fatigue data under comparable states of mobile dislocation density is emphasized, particularly for materials exhibiting pronounced tensile yield point, in order that meaningful comparisons can be made between different materials. (auth)

25689 THERMOMECHANICAL WORKING OF ASTROLOY. Hotzler, R. K. (Polytechnic Inst., Brooklyn); Maciag, R. J.; Fischer, G. J.; Troc, E. Met. Trans.; 1: 963-7(Apr 1970).

Astroloy was warm rolled at temperatures between 1450 and 1800°F, and directly aged in the temperature range from 1300 to 1600°F. Room temperature tensile strengths of 250 ksi and 0.2% yield strengths of 200 ksi were obtained by subjecting the alloy to a 20% reduction at 1550°F followed directly by an 8-hr aging treatment at 1600°F. The tensile properties of the thermomechanically treated material remained superior to those of normally heat treated astroloy up to test temperatures of 1800°F. The warm working primarily served to refine both the γ' precipitate and the grain boundary carbides. Preliminary stress rupture tests have indicated that the resulting thermomechanically treated material is markedly inferior to the normally heat treated alloy when compared on the basis of long time properties. (auth)

25690 TEXTURE AND ROOM TEMPERATURE MECHANICAL PROPERTIES OF DISPERSION STRENGTHENED Ni–Cr ALLOYS. Kilpatrick, D. H. (McDonnell Douglas Astronautics Co., Santa Monica, Calif.); Young, J. D. Met. Trans.; 1: 955-61(Apr 1970).

The effects of preferred crystallographic orientation on the elastic and plastic properties of dispersion-strengthened Ni–Cr alloys were observed at room temperature. One alloy possessed a heavy cube-texture with a twin component while another alloy did not show evidence of a preferred crystallographic orientation. The elastic modulus was found to vary within the plane of the sheet of the textured alloy, depending on the direction of the axis of the tensile specimen, from 22.9×10^6 to 33.1×10^6 psi. The ultimate strength varied between 108×10^3 and 127×10^3 psi again depending upon the orientation of the tensile axis. These variations are related to theories of plastic and elastic behavior in materials. It is concluded that the presence of the preferred orientation acts to texture strengthen the alloy at room temperature. The tensile properties of the two alloys at 2000°F indicated that texture was possibly partially responsible for the excellent high temperature strengths and creep resistance of the dispersion strengthened alloys. (auth)

25691 THERMODYNAMICS OF CADMIUM- AND ZINC-RICH ALLOYS IN THE Cd–La, Cd–Ce, Cd–Pr, Zn–La, Zn–Ce, AND Zn–Pr SYSTEMS. Johnson, Irving; Yonco, Robert M. (Argonne National Lab., Ill.). Met. Trans.; 1: 905-10(Apr 1970).

The thermodynamics of the cadmium- and zinc-rich alloys in the Cd–La, Cd–Ce, Cd–Pr, Zn–La, Zn–Ce, and Zn–Pr systems were studied with a high-temperature galvanic cell method. The values of the standard free energy of formation (kcal per mole) of the intermetallic compounds were given by the equations: ($LaCd_{11}$), $\Delta Gf^0 = -72.3 + 43.6 \times 10^{-3}T$ (670 to 804°K), ($CeCd_{11}$), $\Delta Gf^0 = -70.5 + 44.6 \times 10^{-3}T$ (638 to 884°K), ($PrCd_{11}$), $\Delta Gf^0 = -69.1 + 44.8 \times 10^{-3}T$ (635 to 825°K), ($LaZn_{11}$), $\Delta Gf^0 = -92.6 + 48.0 \times 10^{-3}T$, (705 to 793°K), ($CeZn_{11}$), $\Delta Gf^0 = -87.9 + 45.0 \times 10^{-3}T$ (710 to 1018°K), and ($PrZn_{11}$), $\Delta Gf^0 = -85.3 + 42.7 \times 10^{-3}T$ (696 to 875°K). Equations are also given for the partial molar excess free energies of the lanthanide in dilute solutions of the lanthanide in liquid cadmium or zinc. The enthalpy of formation of the intermetallic compounds is discussed in terms of the crystalline structure of these intermetallic compounds. It is shown that the enthalpy of formation is a linear function of the ratio n/V_c, where n is the number of zinc or cadmium atoms which are near-neighbors of the lanthanide atom and V_c is the volume of the cage formed by the near neighbor cadmium or zinc atoms. A linear dependence of the enthalpy of formation on n/V_c is also found for the intermetallic compounds in several other binary systems. These empirical correlations are discussed in terms of a model which involves localized bonds between the lanthanide and zinc or cadmium atoms. (auth)

25692 EFFECT OF RHENIUM ALLOYING ON LATTICE DILATION OF THE GROUP VI-A REFRACTORY METALS. Garfinkle, M. (Lewis Research Center, Cleveland). Met. Trans.; 1: 1062-3(Apr 1970).

Large rhenium additions had anomalous effects on the room temperature ductility of chromium, molybdenum, and tungsten. The possibility that lattice dilatometry might contribute to this effect was investigated. Lattice parameters were determined for W–Re and Cr–Re alloys. The behavior of the atomic volumes of these alloys and Mo–Re alloy was compared with the ideal variation of atomic volume with composition according to the modified Vegard's rule. Lattice dilatometry was found to play an insignificant role in the rhenium ductilizing effects. (G.M.C.)

25693 AUTHOR'S REPLY [SUPERPLASTICITY IN W–Re ALLOY]. Garfinkle, M.; Witzke, W. R.; Klopp, W. D. Met. Trans.; 1: 1046-7(Apr 1970).

A rebuttal is given to Karim [Met. Trans., 1: 1045-6(1970)] concerning his comments on a paper dealing with the superplasticity in Re–W alloys (previously published and abstracted in NSA as 23: 18233). (G.M.C.)

25694 DISCUSSION OF "SUPERPLASTICITY IN W–Re ALLOYS." Karim, Anwar-ul (Massachusetts Inst. of Tech., Cambridge). Met. Trans.; 1: 1045-6(Apr 1970).

Comments are given on a paper published previously concerning superplasticity in Re–W alloys. The paper was abstracted in NSA as 23: 18233. (G.M.C.)

25695 HIGH TEMPERATURE CREEP BEHAVIOR OF CLASS I AND CLASS II SOLID SOLUTION ALLOYS. Cannon, W. Roger; Sherby, Oleg D. (Stanford Univ., Calif.). Met. Trans.; 1: 1030-2(Apr 1970).

A means for predicting which alloys will have high temperature creep behavior similar to Class I alloys (behavior different from pure metals) or Class II alloys (behavior similar to pure metals) is discussed. The size difference between the solute and solvent atoms and the elastic modulus of the solvent permitted a ready separation of the alloys into the two classes. (G.M.C.)

25696 CLEAVAGE IN BERYLLIUM MONOCRYSTALS. Govila, R. K.; Kamdar, M. H. (Martin Marietta Corp., Baltimore). Met. Trans.; 1: 1011-18(Apr 1970).

A study was made of the initiation and propagation of cleavage cracks in the basal (0001) plane of beryllium monocrystals. The double cantilever cleavage technique was used to determine the energy, ϕ_p, to propagate cleavage cracks, as a function of temperature, purity of material, and alloying. ϕ_p for 3-pass zone-refined Pechiney SR grade beryllium remained essentially constant at ~2100 ± 100 ergs per sq cm over the temperature range −192 to −72°C, and then increased with temperature due to plastic relaxation in the vicinity of the crack tip. This value was in good agreement with Gilman's theoretical estimate of the surface free energy of the (0001) plane in beryllium. The value of ϕ_p determined from a limited number of specimens of beryllium containing 1.49 wt % Cu, and also of higher-purity distilled beryllium, was somewhat greater than that for Pechiney material, namely ~3000 ergs per sq cm. The energy to initiate cleavage fracture in beryllium, ϕ_I, also was 2100 ± 400 ergs per sq cm. Since both crack initiation and propagation occur on the (0001) plane, ϕ_I should be, and is seen to be, essentially identical with ϕ_p. (auth)

25697 EFFECTS OF PARTICLES ON FRACTURE PROCESSES IN MAGNESIUM ALLOYS. Calhoun, C. D.; Stoloff, N. S. (Rensselaer Polytechnic Inst., Troy, N. Y.). Met. Trans.; 1: 997-1006(Apr 1970).

The influence of coherent and noncoherent particles on the mechanism of ductile fracture was studied in two magnesium base alloys: Mg–3.7% Th–0.4% Zr and Mg–0.6% Zr. The ternary alloy was tested in the solution treated condition, and as a function of aging time at the temperature of peak hardening, 325°C; the binary alloy was tested in the solution treated condition and after hydriding to form ε-ZrH$_2$ particles. Fractographic studies were carried out on smooth-bar and notched tensile samples after testing at −196, 25, and 210°C. Fractographic features observed in the solution treated alloys were explainable in terms of the operative slip systems in magnesium. Features observed in aged Mg–Th–Zr and hydrided Mg–Zr were related to particle size, morphology, and distribution, with emphasis on dimple-particle relationships. Coherent, plate-like particles (250Å long) produced dimples in Mg–Th–Zr, as did larger, noncoherent particles. However, many cases of dimple formation without associated particles also were noted. Microvoid sizes observed by light microscopy were 20× dimple sizes revealed by electron fractography. When submicroscopic voids (<0.5 μ) associated with cracked particles were present, lateral growth of these voids did not occur prior to fracture. It was concluded that microvoid coalescence, as classically pictured, was not the failure mechanism in these alloys nor was it the mechanism of formation of dimples. (auth)

25698 CORROSION STABILITY OF MOLYBDENUM COATINGS OBTAINED BY THE METHOD OF CONTACT MELTING. Bichuya, A. L.; Garasim, Yu. A.; Uel'skii, A. A.; Chaevskii, M. I. (Physico-Mechanical Inst., Lvov). Fiz.-Khim. Mekh. Mater.; 5: 704-8(1969). (In Russian).

The corrosion stability and fatigue strength of molybdenum coatings which were obtained by contact melting on steel were studied, and showed that the application of such a coating on EI 437 steel increased the fatigue strength by a factor of 4. (tr-auth)

25699 DYNAMIC PROPERTIES OF HIGH-PURITY BERYLLIUM. Christman, D. R.; Froula, N. H. (General Motors Corp., Warren, Mich.). AIAA (Amer. Inst. Aeronaut. Astronaut.) J.; 8: 477-82(Mar 1970).

Tests were conducted on high-purity beryllium plate to determine the Hugoniot equation of state and shock wave profile up to 50 kbar, and the spall threshold for elastic pulse widths of 0.2, 0.4, and 0.8 μsec, using flat-plate impact techniques. Tests were carried out at material temperatures of 22°C and 260°C. This beryllium was found to have a two-wave elastic-plastic structure with a highly ramped transition from the elastic precursor to the plastic wave. No change in the material equation of state was observed for a temperature increase of 22°C to 260°C. The spall threshold (as defined by the onset of microcracking) was found to be time dependent, with impact velocity required for spall increasing with decreasing pulse width, and temperature dependent, with velocity increasing with increasing temperature. (auth)

25700 TUBULAR COMPOSITE STRUCTURAL ELEMENTS HAVING ZERO THERMAL EXPANSION. Dow, N. F.; Rosen, B. W. Contract NAS 1-7659. Israel J. Technol.; 7: 209-18 (1969).

A number of engineering applications require structural members of high stiffness and low coefficient of thermal expansion. Recent developments in the analysis of thermal expansion coefficients of composite materials have made possible the thermoelastic evaluation of fibrous composites for such applications. The structural efficiency of tube columns having a zero axial coefficient of thermal expansion is discussed. Composites formed by embedding planar and three-dimensional arrays of fibers in a homogeneous matrix material were studied theoretically. Guidelines for the achievement of thermal stability, along with high strength and stiffness, were developed. Zero coefficient of thermal expansion in the axial direction can be achieved with a variety of practical constituents and configurations. Three-dimensional fiber arrays were found to result in materials substantially stronger and stiffer than those having planar fiber arrays. Certain of these materials are most attractive for purely structural (nonthermal) applications. (auth)

25701 EXPERIMENTAL STUDY OF THE HEAT CONDUCTIVITY OF POTASSIUM AND SODIUM–POTASSIUM ALLOYS. Shpil'rain, E. E.; Krainova, I. F. (Inst. of High Temperatures, Moscow). Teplofiz. Vys. Temp.; 7: 172-5(1969). (In Russian).

The thermal conductivity of high-purity, 99.97 wt % K was determined within the 97 to 900°C temperature range. The following correlation was obtained between λ, expressed in kcal/mole °C, and the temperature, in °C: $\lambda = 50.8 - 0.00297\ t$. The deviation of the data was between about 6.4 to −8.3%. Similar experiments were carried out with NaK alloys, containing 17.1, 32, 49.8, 70, 77.2 (eutectic) and 85.2% K, using air instead of the previously employed argon atmosphere. Comparison of the results with data reported in the literature revealed only minor differences, well within the limits of experimental error; best agreement was achieved with the values reported by I. I. Novikov et al. The Lorentz number was found to agree with the mean value reported for alkali metals. The data were used to construct the thermal conductivity diagram for the 100, 300, 500, 700 and 800°C isotherms. A peak in the thermal conductivity was noted for the eutectic point; this may be due to the formation of the compound NaK$_2$. (TTT)

25702 DESORPTION OF TRITIUM INJECTED INTO METALS. Strizhak, V. I.; Primenko, G. I. (Kiev State Univ.). Ukr. Fiz. Zh.; 15: 169-71(Jan 1970). (In Russian).

A method based on the recording of neutrons from the T(d,n) reaction was developed for studying the desorption of tritium during the heating of targets for neutron generators; a 5-MeV-threshold stilbene scintillation counter was used for the measurements. The Cu foil activated by 14-MeV neutrons from the T(d,n) reaction served for the calibration of the counter while 24-mm diameter and 1-mm thick metal discs exposed to injected tritium ions accelerated to 120 keV were used as target. The temperature of the targets was measured by thermocouples. The tritium-injected sample was bombarded with a deuterium ion beam. It was found that the β activity of the target decreases by several percent after the first two days, reaching soon a negligible value. Thus, the decrease of tritium from the target after interruption of the irradiation was much smaller than upon heating; most of the loss was found to occur above 200°C. Therefore, in order to decrease the release of tritium from the target, the beam must be focused less sharply on the target, keeping its temperature below 200°C. (TTT)

25703 ENERGY TRANSFER IN THE Al/Al$_2$O$_3$ SYSTEM. PART I. THE INFLUENCE OF VISIBLE, UV LIGHT, AND γ-IRRADIATION ON THE SURFACE CHARGE IN THE Al/Al$_2$O$_3$ SYSTEM. Siejka, Juliusz; Owczarczyk, Andrzej; Minc, Stefan (Inst. of Nuclear Research, Warsaw. Univ. of Warsaw). Nukleonika; 14: 1097-1111(1969). (In Polish).

A method adapted to measuring the surface charge appearing during anodic oxidation of the Al/Al_2O_3 system is described. The effect of the voltage of oxide layer formation and the current density at the end of the anodic oxidation on the density of the surface charge were investigated. Results of the investigations of the effects of visible and uv light on the current density at the surface and the surface charge were used to estimate the energy of electron traps at the surface level. It was concluded that adsorption of H_2O markedly effects the decrease of surface charge. (auth)

25704 EFFECT OF CARBON ON THE ELASTICITY AND LONG-TERM HARDNESS CHARACTERISTICS OF NIOBIUM AT HIGH TEMPERATURES. Nadezhdin, G. N.; Malashenko, I. S. Probl. Prochnosti; 1: 83-5(Aug 1969). (In Russian).

The effect of carbon on the elasticity modulus and hot hardness at high temperatures of niobium containing 0.1 and 0.15 percent carbon was studied. It is found that carbon enhances the diffusion processes in niobium above 1000°C and thus increases the softening tendency in this metal. To counteract this, a small addition of zirconium is recommended. (IAA)

25705 PROPERTIES AS HIGH-TEMPERATURE MATERIALS OF THE REFRACTORY METALS TITANIUM, NIOBIUM, TANTALUM, MOLYBDENUM, AND COBALT AND OF THEIR ALLOYS. PART I. Wiedemann, K. H. (Institut fuer Reaktorforschung, Wuerenlingen, Switzerland). Metall; 24: 144-9(Feb 1970). (In German).

A survey is made of the properties of the metals Ti, Nb, Ta, Mo, and Co and their most important alloys. For comparison newly developed research alloys and stainless steel were used to show development tendencies. (tr-auth)

25706 METALLKUNDE. II. EIGENSCHAFTEN GRUNDZUEGE DER FORM- UND ZUSTANDSGEBUNG. (Metallography. II. Properties; Characteristic Features of the Shaping and Conditioning). Borchers, Heinz. Sammlung Goeschen Band 433/433a. Berlin; Walter de Gruyter and Company (1969). 240p. DM 5,80.

The primary properties and characteristics of metals and the temperature dependence of the properties of both metals and alloys are discussed. The most important lattice faults are reviewed. Methods used for shaping and conditioning of metals and alloys are described. These include electrolytic precipitation, precipitation from the gaseous phase, metal spraying, sinters, melting and pouring, heat treatment before consideration of deformation and recrystallization, deformation, heat treatment after deformation, heat deformation, surface treatment, and metal joining. Unintended metal perturbations by erosion, cavitation, and corrosion are discussed. (J.S.R.)

25707 SOME STUDIES OF FRICTION IN NUCLEAR ENVIRONMENTS. Blampin, B. Mec. Elec.; 241: 13-24(Jan 1970). (In French).

In the first part, friction and corrosion of sulfided stainless steels were studied. A sticking phenomenon due to the formation of a very adhesive Fe_3O_4 layer, was discovered by corrosion tests. Sticking occurred only on parts remaining motionless for several hundred hours at temperatures near 400°C. The smaller the friction rates, the better was the friction behavior. At low temperatures, the friction coefficient was high. At high temperatures, the friction coefficient was low owing to Fe_3O_4 formation. The Fe_3O_4 layer did not prevent wear and tear of surfaces and of underlying metal. The second part of this work compared some surface treatments. These treatments were chromization, ionic nitriding, sulfidation, and graphite-calcium fluoride process. This last, alone, may be successfully applied between 0 and 500°C. Then friction in liquid sodium was studied. Tests were performed in a tribometer of plane on plane contact type which allowed loads of 50 kg/cm^2 and maximum rates of m/s to be attained. Wetting was studied. The effect of initial oxidation and oxygen trapping on friction is pointed out. The oxygen content can modify preferential classification of friction pairs. After draining the sodium bath, sodium layers sticking on test pieces due to wetting acted as lubricants. (France)

25708 VANADIUM AND ITS ALLOYS. Savicky, E. M.; Efimov, J. V. Planseeber. Pulvermet., 17: 103-10(July 1969). (In German).

Vanadium alloys can be divided into four categories according to the order of magnitude of the chemical interaction between the two elements of binary V systems. The characteristics of the four categories and examples of each are given. The phase diagram and the concentration T_C diagram of binary systems of V with Mg, Sc, Ti, Nb, and Si are presented. The effects of alloying elements on the melting points and hardness are shown diagrammatically. (44 references) (J.S.R.)

25709 EFFECT OF SURFACE OXIDATION ON THE THERMIONIC WORK FUNCTION OF BERYLLIUM. Jerner, R. Craig; Magee, Charles B. (Univ. of Denver). Oxidation Metals; 2: 1-9(Spring 1970).

The thermionic work functions of five different beryllium samples were studied as a function of the degree of surface oxidation. The state of oxidation of each sample was determined by visual observation and by analysis of x-ray diffraction patterns. The data were analyzed by the Schottky plot-Richardson plot method. One wire was completely oxidized to BeO and its Richardson work function was found to be 3.80 ± 0.06 eV and the thermionic constant was 31 A/cm^2-°K^2. From visual and x-ray analyses of the various samples, it is concluded that the lowest work function determined for any of the beryllium samples, 3.22 ± 0.08 eV, is the closest to the work function of pure polycrystalline beryllium metal. (auth)

25710 MECHANICAL PROPERTIES OF THE TiAl6V4 TITANIUM ALLOY AT ELEVATED AND SUBZERO TEMPERATURES. PART II. 1. INFLUENCE OF THE FORM FACTOR ON THE DYNAMIC ENDURANCE STRENGTH AT AMBIENT AND SUBZERO TEMPERATURES. Wellinger, K.; Wittwer, H.-J. Metall, 23: 1012-20(Oct. 1969). (In German).

The test apparatus and experimental set-up are described. Stress diagrams for stress-pressure cycling and stress threshold studies were made and the results are tabulated. The stress pattern and the dependence of the fracture limit load on the type of stress, the sample shape, and the test temperature were determined. The notch effect, notch sensitivity, and support effect during cycling were also studied. (J.S.R.)

25711 SOLID SOLUTION HARDENING OF SILVER CRYSTALS BY CADMIUM. Kan, T.; Haasen, P. (Univ., Goettingen, Ger.). Mater. Sci. Eng.; 5: 176-8(1969-70).

Solid solution hardening of Ag-Cd alloy crystals was investigated with particular emphasis on the solute concentration dependence of the plateau stress. An analysis of results, shown in curves representing critical resolved shear stress versus temperature, is presented. (J.R.D.)

25712 BURST STRENGTH OF CIRCULAR PLATES WITH REINFORCED OPENINGS. Salmon, M. A. (IIT Research Inst., Chicago); Belytschko, T. pp 175-85 of Pressure Vessel Technology. Pt. I. New York; American Society of Mechanical Engineers (1969).

From 1st International Conference on Pressure Vessel Technology, Delft, Netherlands. See CONF-690906(Pt.1).

An experimental and theoretical investigation was conducted concerning the effect of reinforced openings on the burst strength of ductile plates when subjected to pressure loads. Circular plates with circular openings reinforced by annular rings were considered; the area replacement ratios of the rings varied from 1.0 to 2.5. The analytical solution assumed the plate to be a membrane and took into account the large-strain, large-displacement, and strain-hardening effects. The analytical results agree quite well with the results observed experimentally. Both investigations showed that the burst strength decreases as the rigidity of the reinforcement, i.e., its area-replacement ratio is increased. Furthermore, both the analysis and experiments demonstrated that for heavy reinforcements the failure was of an instability type caused by a localized thinning that occurs at the edge of the reinforcement. (auth)

25713 REQUIREMENTS WITH RESPECT TO INSPECTION AND SAFETY CONSIDERATIONS IN THE CONSTRUCTION OF THICK-WALLED STRUCTURAL ELEMENTS. Mueck, G. H. (German Association for the Surveyance of Plants, Duisburg, Ger.). pp 1083-96 of Pressure Vessel Technology. Pt. II. New York; American Society of Mechanical Engineers (1969).

From 1st International Conference on Pressure Vessel Technology, Delft, Netherlands. See CONF-690906(Pt.2).

The use of subeutectoid, bainitic Mn, Cr, Mo, NiV-B-alloyed steels in the construction of thick-walled pressure vessels has led to problems for the manufacturers of the structural elements, for the processing enterprise, and even for the organizations for technical supervision, problems that often enough are not easily solved. The combined effect of chemical composition, mechanical-technological properties, heat treatability, manufacture, weldability, and loading conditions must be clarified by detailed programs of investigation of common validity, owing to the fact that hypotheses and extrapolations not sufficiently covered by experience would affect the safety of the construction. (auth)

25714 EVALUATION OF PRESSURE VESSEL DESIGN CRITERIA FOR EFFECT OF MEAN STRESS IN LOW-CYCLE FATIGUE. Dubuc, J.; Vanasse, J. R.; Biron, A.; Bazergui, A. (Ecole Polytechnique, Montreal). pp 1253-66 of Pressure Vessel Technology. Pt. II. New York; American Society of Mechanical Engineers (1969).

From 1st International Conference on Pressure Vessel Technology, Delft, Netherlands. See CONF-690906(Pt.2).

Low-cycle fatigue results are presented and discussed for two nickel steels relative to the effect of mean strain or mean stress. From these results, and from similar data already published on two other materials commonly used in pressure vessel fabrication, the procedure used in Section III of the ASME Boiler and Pressure Vessel Code is evaluated for strain-controlled fatigue. The ratio of mean strain to total strain range for all tests varied between approximately −1 and +1. It was found that for these materials, in the range of lives considered (between 100 and 100,000 cycles) and for a mean strain of the order of the strain range, the results were essentially independent of mean strain, and, therefore, the code procedure is conservative for these conditions. (auth)

25715 EFFECTS OF HEAT-TREATMENT ON THE HIGH-TEMPERATURE DUCTILITY AND FRACTURE OF 20 Cr/25 Ni/Nb STABILISED AUSTENITIC STEEL. Gittins, A. (Central Electricity Research Labs., Leatherhead, Eng.). J. Mater. Sci.; 5: 233-9(Mar 1970).

Stabilization of 20 Cr/25 Ni steel by niobium not only increased the creep resistance but eliminated the tendency for cracking and thereby enhanced the ductility. No change in density was detected in fine-grained specimens solution-treated at 1000°C until well into tertiary creep, and elongations of 75 to 150% were obtained. After a solution-treatment at 1250°C the creep resistance was further increased and denuded zones were formed near grain boundaries. This caused the strain to be concentrated in grain boundary regions during creep, leading to the formation of both surface- and wedge-cracks at grain boundaries. However, in contrast to a niobium-free steel, these did not nucleate until the end of the secondary creep. (auth) (UK)

25716 ALUMINUM–BORON COMPOSITES FOR AEROSPACE STRUCTURES. Christian, J. L.; Forest, J. D.; Weisinger, M. D. (General Dynamics Corp., San Diego, Calif.). Metal Progr.; 97: No. 5, 113; 116; 118; 120; 122; 126(May 1970).

Advantages of aluminum-boron composite materials for aerospace components including light weight, high strength-to-weight ratio, stiffness, postbuckling strength, excellent fabricability, and ease of joining, are discussed. (J.R.D.)

25717 ELECTRON FRACTOGRAPHIC STUDY OF THE URANIUM ALLOY, MULBERRY. Miglionico, C. J. (Sandia Labs., Albuquerque, N. Mex.). pp 223–42 of Proceedings of Second Annual Technical Meeting, International Metallographic Society, Inc., September 8–10, 1969, San Francisco, California. /Bender, J. H. (ed.). Los Alamos, N. Mex.; International Metallographic Society, Inc. (1970).

See CONF-690920.

The results of the preliminary fractography on the uranium alloy, Mulberry, and the comparison of the topographies by replication and scanning electron microscopy are presented. Many fractures were produced within the laboratory in different environments. From these laboratory experiments, six types of failure were identified: fatigue, from a fatigue pre-crack Charpy specimen; dimple rupture, from tensile specimens; intergranular cracking; quasi-clevage; and two mixed modes — intergranular and dimple rupture and intergranular and quasi-cleavage — all from the fractures produced in various corrosive environments. The results of this characterization provided conclusive evidence that Mulberry was sensitive to its environment and, therefore, appeared to be susceptible to both the stress corrosion and hydrogen embrittlement types of failure. (auth)

25718 LOW TEMPERATURE DEFORMATION OF Pu–1 w/o Ga. Rafalski, Anthony L.; Seery, William N. (Dow Chemical Co., Golden, Colo.). pp 269–74 of Proceedings of Second Annual Technical Meeting, International Metallographic Society, Inc., September 8–10, 1969, San Francisco, California. /Bender, J. H. (ed.). Los Alamos, N. Mex.; International Metallographic Society, Inc. (1970).

See CONF-690920.

An investigation of low temperature plastic deformation of Pu-1 wt % Ga revealed a slip to twin transition in the mode of deformation from −80 to −196°C. Metallographic techniques were developed to reveal the deformation twins produced at −196°C and to study their crystallographic relation to existing anneal twins and grain boundaries. Methods were developed to analyze slip traces after deformation at −80°C by preparing polished samples for use in the deformation tests. (auth)

25719 THE CONSTITUTION OF THE BINARY EQUIATOMIC ALLOYS OF Zr WITH Fe, Co, AND Ni. Harris, I. R.; Hussain, D.; Barraclough, K. G. (Univ. of Birmingham, Eng.). Scr. Met.; 4: 305-7(Apr 1970).

Preliminary observations are reported in the structure and mechanical properties of equiatomic Co−Zr alloys and Co−Ni−Zr alloys. (G.M.C.)

25720 SELF DIFFUSION IN BERYLLIUM METAL. Chabre, V.; Geissler, E. (CNRS, Grenoble, France). Scr. Met.; 4: 255-7(Apr 1970).

The activation energy for atomic diffusion in foil and powdered beryllium metal was measured by using a nuclear magnetic resonance method. The smallness of the value of the apparent activation energy, 0.36 eV, suggested a non-diffusive process relying on vacancy motion. It is proposed that the impurity atoms (i.e., carbon) in substitutional sites in beryllium diffuse (not the beryllium) by interchange, acting as vacancies. (G.M.C.)

25721 STUDY OF INTERNAL FRICTION DUE TO THE GRAIN BOUNDARIES IN MAGNESIUM. Delaplace, J.; Nicoud, J. C.; Trabut, L. (CEN, Grenoble, France). J. Nucl. Mater.; 35: 167-76(May 1970). (In French).

The variation of internal friction in magnesium was studied as a function of temperature in the range 20 to 350°C by means of a low-frequency pendulum. Doubly sublimed magnesium containing less than 500 ppM of impurities, zone-refined magnesium, and commercial (99.8%) magnesium were used. With the annealed doubly sublimed magnesium around 185°C at one cs an internal friction peak was observed which presented all the characteristics of a relaxation peak, and which was interpreted as a grain-boundary peak. The activation energy for this peak, measured by changing the frequency, was 31.7 kcal/mole, whereas the activation energy for volume self-diffusion was 32 kcal/mole. The width of the peak exceeded the theoretical width by a factor of 2. The influence of irradiation and of deformation on the grain-boundary peak was studied. After neutron irradiation at low temperature (9×10^{18} fast neutrons/cm^2) the peak was slightly displaced toward higher temperatures and its profile was appreciably altered. When a specimen was plastically deformed in compression at low temperature, a very large increase in the internal friction was observed at the normal peak temperature, and this completely masked the grain-boundary peak itself; the appearance of this appeared to be linked to recrystallization. (auth)

25722 MECHANICAL PROPERTIES OF THE TITANIUM ALLOY Ti–6Al–4V AT HIGH AND LOW TEMPERATURES. PART II. INFLUENCE OF THE FORM FACTOR ON THE DYNAMIC ENDURANCE STRENGTH AT AMBIENT AND SUB-ZERO TEMPERATURES. Wellinger, K.; Wittwer, H.-J. (Univ., Stuttgart). Metall; 23: 1270-6(Dec 1969). (In German).

Formed titanium alloy Ti-6Al-4V was exposed to continuous cyclic stresses. Effects of notching and low temperatures were studied. At −193°C the oscillatory strength of the unnotched samples displayed a striking enhancement. Sharply notched samples displayed a barely noticeable increase in strength. All available information on oscillatory resistance of the titanium alloy at low temperatures was compiled in 16 diagrams and 4 tables. (H.B.G.)

25723 THE EFFECT OF ELASTIC ANISOTROPY ON THE ELECTRON MICROSCOPE IMAGES OF SMALL DEFECT CLUSTERS IN NEUTRON IRRADIATED COPPER AND GOLD. McIntyre, K. G.; Brown, L. M.; Eades, J. A. (Cambridge Univ., Eng.). Phil. Mag.; 21: 853-6(Apr 1970).

The theory of Yoffe was compared with experiment. Her theory predicted the direction of streaking of electron microscope images of Frank loops in copper and gold quite well; better than older theories based on isotropic elasticity. (auth) (UK)

Structure and Phase Studies

Refer also to abstracts 25796, 26096, and 26097.

25724 (ANL–7417, pp 71-7) PHYSICAL METALLURGY OF ACTINIDE METALS AND COMPOUNDS. (Argonne National Lab., Ill.).

Research and development results are reported on preparation of high-purity plutonium, preparation of single-crystal UP, effects of pressure on phases in Pu, wave emission during metal transformations, internal friction of Np, defects in PuO_{2-x}, and defects in UO_{2+x}. (J.R.D.)

25725 (ANL–7417, pp 85-104) ELECTRONIC AND MAGNETIC STRUCTURES OF METALS AND ALLOYS. (Argonne National Lab., Ill.).

Research results are presented on electronic properties of actinides, magnetic properties of Pu compounds, magnetic properties of monocrystals of U, spin-lattice relaxation of ^{31}P in UP, NMR of ^{14}N in UN, magnetic properties of UP and UAs, magnetic properties of NpO_2 and NpC, positron annihilation, magnetic properties of dilute alloys, magnetic moments in Fe alloys, neutron scattering by ferromagnetic alloys, electronic structure of transition metal alloys, NMR of VNb alloys, spin relaxation time in beta manganese, Moessbauer effect in solid solutions, heat of formation of transition metal alloys, thermodynamic properties of Pd–Rh alloys, intermediate phases, impurity screening of metals, and electron spin resonance in $CdCl_2$. (J.R.D.)

25726 (CEA-R-3914) PHYSICO-CHEMICAL AND MECHANICAL PROPERTIES OF ALLOYS IN THE MAGNESIUM–YTTRIUM SYSTEM. Miannay, Dominique (Commissariat a l'Energie Atomique, Bruyeres-le-Chatel (France). Centre d'Etudes). Feb 1970. 164p. (In French). Dep. CFSTI (U. S. Sales Only).

The equilibrium diagram of the magnesium-yttrium system was determined for weight concentrations of yttrium between 0 and 60 per cent. The chemical diffusion parameters in the solid-solution region and the resistivity of low-content alloys were also investigated. The plastic behavior, both under tension and during creep, of alloys with low Y contents was studied. At both high and low temperatures, deformation was activated thermally: the energy and volume of activation were calculated. At low temperatures, the softening due to alloying was caused by a change in the kind of obstacles to the movement of dislocations: the dissolved atoms and forest trees existing in low-content alloys were replaced by microprecipitates in the alloys with the highest contents. At high temperatures the deformation was governed by the movement of jogged screw dislocations. At intermediate temperatures the deformation is athermal and corresponds to the movement of edge dislocations in the overall stress field produced by the dissolved atoms. The apparent activation energies for creep were determined at high temperature. At moderate temperatures, static and dynamic ageing phenomena were demonstrated. Their domains of existence, as far as temperature and rates are concerned, were determined. An explanation is proposed to account for their occurrence and for their kinetics. (auth) (France)

25727 (LFEN-99-a) REVELATION OF DISLOCATIONS IN NIOBIUM BY MEANS OF ETCH PATTERNS. da Cunha Monteiro, Jose Manuel (Junta de Energia Nuclear, Sacavem (Portugal). Laboratorio de Fisica e Engenharia Nucleares). 1969. 29p. (In Portuguese). Dep. CFSTI (U. S. Sales Only).

The effect of temperature and of time on the density of dislocations in cold-deformed Nb was studied. A technique for the revelation of the dislocations by electrolytic dissolution was established. The influence of orientation of the grains under the revelation conditions was verified and the properties necessary to obtain the maximum information possible on the density and distribution of the dislocations were defined from the preparation conditions. (tr-auth)

25728 THE STACKING FAULT PROBABILITIES AND LATTICE SPACINGS OF SILVER-RICH Ag–Pd–Cd ALLOYS. Rhee, S. K. (Bendix Corp., Southfield, Mich.). Met. Trans.; 1: 771-3(Apr 1970).

The deformation stacking fault parameter, α, was determined from x-ray peak shift measurements on filings of silver-rich Ag–Pd–Cd solid solutions. In the Ag–Cd binary alloys, α increased exponentially with the cadmium content, from 3×10^{-3} for pure silver to 19×10^{-3} for 80 Ag–20 Cd. As palladium was added to the Ag–Cd binary alloy, α decreased in such a manner that the effect of cadmium was counter-balanced by palladium until both were present in equal proportions and, thereafter, α remained constant. The results are compared with previous determinations on other binary alloys. The lattice parameter, α, also was measured on annealed samples. α increased linearly with cadmium up to 20 at. % Cd. As palladium was added to the Ag–Cd alloy, α decreased more rapidly than it increased with cadmium. The rate of decrease became less rapid when palladium was present in excess of cadmium. (auth)

25729 FORMATION OF GAMMA PHASE IN VANADIUM PERMENDUR. Fiedler, H. C.; Davis, A. M. (General Electric Research and Development Center, Schenectady, N. Y.). Met. Trans.; 1: 1036-7(Apr 1970).

The γ phase in vanadium Permendur (2% V–49% Co–49% Fe) was observed after heating cold rolled strip below its recrystallization temperature. The microstructure of the γ phase is described and compared to that of a strip recrystallized prior to the heat treatment. (G.M.C.)

25730 THE USE OF HYDROGEN ION FIELD-ION MICROSCOPY TO REVEAL CARBIDE MORPHOLOGY IN AN ISOTHERMALLY TRANSFORMED Fe–V–C ALLOY. Schwartz, David M. (San Fernando Valley State Coll., Northridge, Calif.); Ralph, Brian. Met. Trans.; 1: 1063-6(Apr 1970).

The fine scale microstructure of an Fe–2 wt % V–0.2 wt % C alloy following isothermal transformation between 600 and 700°C was elucidated by field-ion microscopy. The size distributions of the V_4C_3 precipitating phase were related to microhardness and the spatial distribution of the carbide phase in ferrite was defined. (G.M.C.)

25731 EFFECTS OF THERMAL CYCLING ON THE DENSITY OF CADMIUM WITH BISMUTH ADMIXTURES. Savitskii, A. P.; Egorov, I. I.; Savitskii, K. V. (Siberian Physical Technical Inst., Tomsk, USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 6, 21-7(1969). (In Russian).

The effects of thermal cycling on the density of cadmium with bismuth additions were studied with special attention to the effects of the rate of heating up to the exposure temperature, rate of cooling from this temperature, duration of exposure at the maximum temperature, and the effects of the bismuth content. (tr-auth)

25732 STUDIES OF GRAIN-BOUNDARY SELF-DIFFUSION IN CADMIUM. Guenther, F.; Haessner, A.; Oppermann, L. (Bergakademie, Freiberg i. B.). Isotopenpraxis; 5: 461-3(1969). (In German).

Results of investigations of grain boundary self-diffusion in Cd using ^{115m}Cd tracer are discussed. (J.R.D.)

25733 NEUTRON DIFFRACTION STUDY OF α-URANIUM AT LOW TEMPERATURES. Lander, G. H.; Mueller, M. H. (Argonne National Lab., Ill.). Acta Crystallogr., Sect. B; 26: 129-36(1970).

Neutron diffraction measurements were made on two single crystals of α-uranium in the temperature range 10°K to room temperature. The previously reported variations in the y-positional parameter of the uranium atom are confirmed. There is no deviation from the orthorhombic structure nor any magnetic ordering at low temperature. At low temperature, the increases in the strong nuclear intensities, which are as great as 45% in some cases, are due to a change in the extinction parameter. This effect, observed at various neutron wavelengths, is related to the size of the perfect domains in the crystal and is reversible. (auth) (Denmark)

25734 CRYSTAL STRUCTURE OF $RhBe_{6.6}$. Johnson, Quintin (Univ. of California, Livermore); Smith, Gordon S.; Krikorian, Oscar H.; Sands, Donald E. Acta Crystallogr., Sect. B; 26: 109-13(1970).

The crystal structure of a compound in the beryllium-rich portion of the Rh–Be system was determined. The final structure corresponds to the composition $RhBe_{6.6}$. The crystals are hexagonal, with probable space group $P\bar{6}m2$. The structure is closely related to the $D2_d$ type. The non-integer formula is a result of partial occupancy of two sites. Identical powder patterns were observed in the Fe–Be, and Co–Be and the Ir–Be systems. Compositions for the Fe–, Co–, and Ir–Be compounds were not determined. In the case of $FeBe_x$, this unit cell and structure account for the powder pattern of 'ζ-$FeBe_{11}$' (J. Metals, 1, 285). This suggests that a considerable compositional variation might be expected. (auth) (Denmark)

25735 COLONY TO TWO-PHASE DENDRITE TRANSITION IN Al–$NiAl_3$ EUTECTIC STRUCTURES BY ADDITIONS OF BARIUM, CERIUM, AND CESIUM TO THE MELT. Rohatgi, Pradeep K. (Indian Inst. of Tech., Kanpur). Met. Trans.; 1: 1041-3(Apr 1970).

The effect of small additions of barium, cerium, and cesium on the eutectic colony structure produced on rapid freezing of an Al–7.6% Ni alloy was studied. The additions to the melt caused the solidification pattern of Al–$NiAl_3$ eutectic to change from colony to dendritic structure by primarily altering the growth conditions. (G.M.C.)

25736 STRUCTURAL TRENDS IN THE ELEMENTS. Kasper, John S. (General Electric Research and Development Center, Schenectady, N. Y.). Trans. Amer. Crystallogr. Ass.; 5: 1-18 (1969).

A survey is given of the effects of pressure, up to 100 kilobars and temperature up to 1400°, on the phase diagrams and resistances of Ce, the alkali metals, Ba, the alkaline-earth metals, the rare-earth metals, Group IVA elements, Zn, Cd, Hg, Fe, Ga, In, Tl, Group IVB elements, Group VB elements, Se, and Te. (Selenium–Tellurium Abstr.)

25737 BRITTLE-DUCTILE TRANSITION OF CUBIC-SPACE-CENTERED METALS TAKING TUNGSTEN AND MOLYBDENUM INTO SPECIAL CONSIDERATION. PART II. THEORIES OF BRITTLE–DUCTILE TRANSITIONS. Pink, E. Metall; 24: 131-8(Feb 1970). (In German).

The transition from ductile-to-brittle behavior occurring at a given temperature in cubic space-centered metals was affected primarily by the characteristics of the lattice. The increased yield point at low temperature is valid as indirect reason for the embrittlement. Methods which lead to a lowering of the yield point displaced the brittle–ductile transition to lower temperatures. In the recrystallized metals Mo and W the grain boundary brittleness is superimposed on the lattice effect. Macrofractures were introduced by transcrystalline fissuring in the microrange which developed in intercrystalline modes. (tr-auth)

25738 STRESS RELAXATIONS AT INTERFACES IN INDIUM AND INDIUM–THALLIUM ALLOYS. De Morton, M. E. (Defence Standards Labs., Maribyrnong, Australia). J. Aust. Inst. Metals; 14: 228-35(Nov 1969).

Low-frequency internal friction and shear modulus measurements were made on pure indium and indium-rich thallium alloys in the fct and fcc phases. Polycrystalline indium does not exhibit grain-boundary relaxations, due to the extreme ease of slip within the grains. A damping peak and shear modulus relaxation was, however, observed in single crystal and polycrystalline indium at −100°C; these effects are believed to be associated with the nucleation and subsequent stress-induced propagation of fine deformation twins in fct indium. It is suggested from shear modulus data and published expansion data that a higher order phase transition occurs in indium at −100°C. Relaxations were observed in polycrystalline indium–thallium alloys at 50°C (0.75 Tm) in both the fct and fcc forms, and these were associated with the motion of grain boundaries. The relaxation strengths measured for grain boundary damping in the fct alloys were larger by a factor of three over those measured for the fcc alloys. An explanation for this behavior is given in terms of grain-boundary sliding assisted by grain deformation through the motion of twin interfaces present in the fct alloys. Activation energies measured for the high-temperature grain-boundary relaxations were significantly greater than for volume self-diffusion; in the fct phase they were 30% higher than for fcc alloys. A coupled relaxation mechanism is suggested to explain these results. (auth) (Australia)

25739 ON THE ROLLING TEXTURE OF TANTALUM MELTED IN THE VACUUM ARC FURNACE. Langer, Emma; Beyer, Bruno (Forschungsinstitut fuer NE-Metalle, Freiberg, Ger.). Neue Huette, 14: 525-8(Sept. 1969). (In German).

Tantalum melted in vacuum arc furnaces establishes a three-layered texture inhomogeneity after rolling. The textures found, however, deviate significantly from those found by other investigators. In a layer close to the surface the normal rolling texture is formed. It is detectable in the sample interior at very high rolling ranges. A thin layer is also found with unclear grain orientation. In the sample interior a single crystal texture is found at medium and high deformation stages. It occurs principally in an intermediate layer. It was assumed that this texture represents a characteristic of the cast metal. (tr-auth)

25740 MODERN METAL PHYSICS AND MATERIAL PROBLEMS. PART 2. EFFECTS OF NATURAL FLAWS, FOREIGN ELEMENTS, AND SEPARATIONS ON THE ALLOYING BEHAVIOR: REQUIREMENTS TO BE SATISFIED BY THE REAL STRUCTURE. Balarin, Manfred; Barthel, Johannes; Schlaubitz, Karl; Schulze, Dietrich. Neue Huette, 14: 532-6(Sept. 1969). (In German).

Interactions of alloys having zero-dimensional structural defects, the behavior of alloying in the presence of precipitation, and requirements on the crystal quality (real structure) for establishment of structural effects were considered on the basis of examples in the literature. The metals discussed are Nb, Ta, Fe, Mo, and W. Factors causing the inhibition of the alloying process are discussed. Interactions between alloys and precipitations are described. Crystal growth in high purity metals is considered. (J.S.R.)

25741 MODERN METHODS OF TESTING THE REAL STRUCTURE. PART 1. DEFECTS OF THE CRYSTALLINE STRUCTURE AND THEIR REPRESENTATION BY MEANS OF THE FIELD-ION AND TRANSMISSION ELECTRON MICROSCOPE. Schulze, Dietrich (Institut fuer Metallphysik und Reinstmetalle, Dresden). Neue Huette, 14: 537-42(Sept. 1969). (In German).

Elements of real structure are outlined. Methods used to represent point faults are given. Alloying detection by image-forming methods are described. Questions concerning the beams in electron microscopes, lattice images, motion contrast, resolution rules, high voltage microscopy, and the preparation of thin crystals are discussed. (J.S.R.)

25742 MICROPROBE ANALYSIS OF FRACTURES. Estill, W. (Sandia Labs., Livermore, Calif.). pp 85-8 of Proceedings of Second Annual Technical Meeting, International Metallographic Society, Inc., September 8–10, 1969, San Francisco, California. /Bender, J. H. (ed.). Los Alamos, N. Mex.; International Metallographic Society, Inc. (1970).

See CONF-690920.

A new method for identifying small particles in fractured surfaces is described. The capability of the method is illustrated by an analysis of a uranium alloy. (auth)

25743 AN ESTIMATE OF THE STACKING FAULT ENERGY OF CADMIUM FROM DISLOCATION LOOP ANNEALING. Westmacott, K. H. (Naval Weapons Center, China Lake, Calif.). pp 353-8 of Proceedings of Second Annual Technical Meeting, International Metallographic Society, Inc., September 8–10, 1969, San Francisco, California. /Bender, J. H. (ed.). Los Alamos, N. Mex.; International Metallographic Society, Inc. (1970).

See CONF-690920.

Quantitative electron metallography was used to study the formation and climb kinetics of dislocation loops in cadmium foils prepared from the bulk. Interesting differences in behavior compared with previous work on vapor-deposited films are observed. In common with other HCP metals which were examined, growth of loops was generally observed during annealing, and a detailed study of these effects showed they were consistent with the oxidation-vacancy injection mechanism proposed for zinc. However, it was possible to remove the oxide layers from the foil surfaces prior to examination and under these circumstances shrinkage of both the faulted and prismatic loops occurred. From a comparison of the loop annealing rates, and an analysis of the climb kinetics using a diffusion controlled model, a value for the stacking fault energy was obtained. (auth)

25744 INTERSTITIAL ORDERING IN TANTALUM. Rao, P.; Thomas, G. (Univ. of California, Berkeley). Scr. Met.; 4: 243-4(Apr 1970).

Comments are made concerning the structure of the interstitially ordered phase obtained on the introduction of carbon—in most cases, nitrogen, and oxygen into tantalum. (G.M.C.)

25745 REPLY TO INTERSTITIAL ORDERING IN TANTALUM. Geiss, R. H.; Lawless, K. R. (Univ. of Virginia, Charlottesville). Scr. Met.; 4: 245-6(Apr 1970).

Comments are given on a paper concerning interstitial ordering in tantalum [Rao et al., Scr. Met., 4: 243-4 (1970)]. (G.M.C.)

25746 VALUES OF SOLUTE-VACANCY BINDING ENERGY IN ALUMINIUM MATRIX FOR Ag, Be, Ce, Dy, Fe, Li, Mn, Nb, Pt, Sb, Si, Y, AND Yb. Råman, K. S.; Das, E. S. D.; Vasu, K. I. (Indian Inst. of Science, Bangalore). Scr. Met.; 4: 291-3(Apr 1970).

Values of the solute-vacancy binding energy were determined for Ag, Be, Ce, Dy, Fe, Li, Mn, Nb, Pt, Sb, Si, Y, and Yb by resistometric measurements of the effects of 0.01 at.% addition of these elements on the clustering rate in an Al−4.4 at.% Zn alloy. (G.M.C.)

25747 ISOTHERMAL GROWTH OF SECONDARY-PHASE PARTICLES IN A DILUTE URANIUM ALLOY. Jovanovic, M. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). J. Nucl. Mater.; 35: 223-30(May 1970).

The growth of secondary-phase particles, in a multi-component uranium alloy with small quantities of molybdenum, silicon, aluminum, and iron, was studied as a function of annealing time and temperature. Thin-film electron microscopy was used. On annealing, the larger particles grew at the expense of smaller ones, thereby reducing the total number of particles. The variation of particle size with time can be best approximated by the equation $r - r_0 = kt^{1/2}$. The calculated value of the activation energy of particle growth was 1.76 eV in the alpha-phase region. (auth)

25748 RECRYSTALLIZATION OF VANADIUM. Guttmann, V. (EURATOM, Petten, Netherlands). Metall; 23: 1277-84 (Dec 1969). (In German).

The process of recrystallization was studied in highly purified polycrystalline vanadium subjected to heavy cold deformation. Grain growth proceeded along several routes of almost equal probability. Somewhat preferred appeared to be growth from subgrains between which boundaries dissolved. Samples that were thinned before heat treatment showed a different behavior in comparison to the mass samples. Recrystallization was delayed and started with extremely large subgrains. (H.B.G.)

Radiation Effects

Refer also to abstract 26691.

25749 (ANL-7417, pp 37) DEVELOPMENT OF THORIUM–URANIUM–PLUTONIUM FUELS. (Argonne National Lab., Ill.).

Results of radiation effects testing of encapsulated Th−U and Th−Pu−U fuels in CP-5 reactor are reported. (J.R.D.)

25750 (ANL-7417, pp 111-24) IRRADIATION EFFECTS AND DEFECTS. (Argonne National Lab., Ill.).

Research results are presented on atomic collision cascades, irradiation hardening of metals, radiation effects on U, radiation-induced defects in metals, radiation effects on thin metal films, Cu, and pure metals. (J.R.D.)

25751 EFFECT OF NEUTRON RADIATION ON DIFFUSION OF ZINC IN INDIUM ARSENIDE. Boltaks, B. I.; Savin, E. P. (Inst. of Semiconductors, Leningrad). Fiz. Tekh. Poluprov.; 4: 567-8(Mar 1970). (In Russian).

The diffusion mechanism of Zn in InAs was investigated under conditions leading to dissociative diffusion processes. Single crystals of n-type InAs with an electron concentration of 5×10^{16} cm^{-3} were used for the experiments, exposing them to an integrated fast neutron flux of 5×10^{16} n/cm^2 at 150°C in a reactor beamhole. The specimens were enclosed in an In foil, placed in a Cd capsule, in order to attenuate the thermal neutron flux. After the irradiation, the electron concentration was 2×10^{17} cm^{-3}. The InAs specimens and the Zn were subjected to diffusion annealing in evacuated quartz containers at 800°C. The concentration distribution of the Zn was determined by measuring the electric conductivity of the diffusion layers. The results indicated that the irradiation lowers the depth of the p-n transition layer to 60 μ; this is probably due to the decrease of the effective diffusion coefficient. The increased concentration of vacancies due to the radiation was found to increase the capture probability of particles, thus reducing the observable diffusion coefficient. It also caused the anticipated increase of solubility. (TTT)

25752 KINETICS OF CAVITY GROWTH IN 20 Cr/25 Ni STAINLESS STEEL. Gittins, A. (Central Electricity Research Labs., Leatherhead, Eng.). J. Mater. Sci.; 5: 223-32(Mar 1970).

The development of cavitation during creep has been examined in an unstabilised 20 Cr/25 Ni austenitic stainless steel, using precise density measurements as an indicator of the level of cavitation. The change in density was proportional to the duration of creep to the power of 3.0 increasing to 4 to 5 just before fracture, and this time exponent was not affected by either grain size or irradiation. Metallographic examination showed that wedge-cracks were the predominant mode of cavitation and helium bubble growth in irradiated specimens increased the rate of crack propagation, thus reducing the ductility. A simple model for the growth of triple-point cracks is used to explain the experimentally observed changes in density. (auth) (UK)

25753 BEHAVIORS OF NITROGEN ATOMS IN IRRADIATED IRON AND IRON ALLOY REVEALED BY INTERNAL FRICTION AND ELECTRON MICROSCOPY. Igata, Naohiro (Tokyo Univ.); Hasiguti, Ryukiti; Seto, Satio. Trans. Iron Steel Inst. Jap.; 10: 21-4(Jan 1970).

The structure changes of iron and an iron alloy induced by neutron irradiation and annealing were investigated from the atomistic point of view. High purity iron, pure iron, and an iron–nickel alloy were irradiated in the Belgian Reactor BR-2. Experiments on Snoek internal friction peaks and electron microscopy were performed. It is concluded that in slowly cooled iron alloy, in which carbon atoms are rather stably precipitated, nitrogen atoms are trapped by irradiation induced point defects to form complexes, which together with interstitial clusters contribute to the irradiation hardening. (auth) (NSA of Japan)

25754 ELECTRON MICROSCOPIC INVESTIGATIONS OF THE PHENOMENA FOLLOWING ION BOMBARDMENT OF METALS. Nenadovic, Tomislav; Rundic, Zorica; Dimitrijevic, Tomislav. Bull. Boris Kidric Inst. Nucl Sci., Ceram. Met.; 20: No. 2, 9-12 (May 1969).

The effects of crystal surface bombardment were investigated using replicas and transmission electron microscopy. Polycrystalline Al, Pt, Au, and U were bombarded in an electromagnetic isotope separator with Ar^+ and Xe^+ ions of energies of 20 to 45 keV. Results show that ion bombardment causes selective sputtering of crystallographic planes in dependence on the orientation of grains of polycrystalline material. Besides the sputtering structure of individual grains, effects of radiation damage of bombarded specimens and precipitation of the incorporated gas in the form of bubbles were found. (auth)

25755 DISLOCATION CLIMB: FIRST CATCH YOUR POISSON. Hesketh, R. V. (Berkeley Nuclear Labs., Eng.). J. Nucl. Mater.; 35: 253(May 1970).

Comments are given on a rebuttal by Nichols [J. Nucl. Mater., 35: 251-2 (1970)] concerning the mechanism for creep of Zircaloy during neutron irradiation. (G.M.C.)

25756 REPLY TO MOSEDALE'S NOTE ON "DISLOCATION CLIMB AND IRRADIATION". Nichols, F. A. (Bettis Atomic Power Lab., West Mifflin, Pa.). Contract AT(11-1)-Gen-14. J. Nucl. Mater.; 35: 251-2(May 1970).

A rebuttal is given to Mosedale [J. Nucl. Mater., 35: 250 (1970)] concerning his comments on a paper dealing with the creep of Zircaloy during neutron irradiation (previously published and abstracted in NSA as 23: 22613. (G.M.C.)

25757 DISLOCATION CLIMB AND IRRADIATION. Mosedale, D. (United Kingdom Atomic Energy Authority, Caithness, Scotland). J. Nucl. Mater.; 35: 250(May 1970).

Comments are given on a paper published previously concerning creep of Zircaloy during neutron irradiation. The paper was abstracted in NSA as 23: 22613. (G.M.C.)

25758 A COMPARISON OF IRRADIATION INDUCED SWELLING AND VOID FORMATION IN TWO AUSTENITIC STAINLESS STEELS. Bloom, E. E.; Stiegler, J. O. (Oak Ridge National Lab., Tenn.). J. Nucl. Mater.; 35: 244-6(May 1970).

The effects of composition on density decrease and microstructural changes in irradiated steels were investigated. Type 304 and titanium-modified Type 304L stainless steels were irradiated with fast neutron fluences of 1.75×10^{22} and 1.53×10^{22} $neutrons/cm^2$, respectively. The density of the Type 304 stainless steel decreased about a factor of four times that of the modified Type 304L stainless steel. Void concentrations of 4.9×10^{15} and 1.1×10^{15} $voids/cm^3$ were obtained for the standard and modified compositions. (G.M.C.)

25759 HIGH-NEUTRON FLUENCE DAMAGE IN AN ALUMINUM ALLOY. King, R. T.; Long, E. L. Jr.; Stiegler, J. O.; Farrell, K. (Oak Ridge National Lab., Tenn.). J. Nucl. Mater.; 35: 231-43(May 1970).

A cold-drawn Al/1 wt % Ni alloy irradiated to 1×10^{22} fast $neutrons/cm^2$ ($E > 0.821$ MeV) and $>2 \times 10^{22}$ thermal $neutrons/cm^2$ at 60°C in an aqueous environment contained polyhedral voids up to 550 Å diameter in concentrations of approximately $10^{15}/cm^3$, and a fine solid precipitate of transmutation-produced silicon. Post-irradiation annealing for 1 hr at temperatures above 220°C caused the voids to disappear; cold pressing the specimens through a 65% reduction in thickness also eliminated most of the voids. The irradiation-induced precipitate coarsened markedly with increasing annealing temperature. Gas bubbles were observed after a 400°C anneal and are believed to be responsible for a large increase in recrystallization temperature. Growth of the bubbles on annealing at temperatures of 530°C and above caused significant swelling. Irradiation-induced strengthening decreased with increasing tensile test temperature and disappeared at about 300°C. Post-irradiation annealing also decreased the strength. Ductility was reduced by irradiation, particularly over the test temperature range ≈100 to ≈260°C. (auth)

25760 THE BEHAVIOUR OF RADIATION-INDUCED GAS IN IRRADIATED ALUMINIUM–LITHIUM ALLOYS. Smith, I. O.; Russell, B. (Univ. of Queensland, St. Lucia, Australia). J. Nucl. Mater.; 35: 137-57(May 1970).

The behavior of radiation-induced gas in neutron irradiated aluminum-lithium alloys was investigated in the temperature range 200 to 600°C. It was found that gas bubbles nucleate homogeneously during neutron irradiation at 75°C. These gas bubbles grow by a migration and coalescence mechanism under the influence of a driving force provided by a nonequilibrium of vacancies. Experimental evidence was obtained for the conservation of lattice strain energy during the growth process so that the internal pressure, P, of the bubble was balanced by the surface tension forces γ such that $P = 2\gamma/r$. The time dependence of the growth process was highly temperature-dependent, varying from $r \propto t^{0.37}$ at 600°C to $r \alpha t^{0.02}$ at 200°C, where r is the mean bubble radius and t the annealing time. Small bubbles were observed to persist after annealing at temperatures of 500°C and below, indicating that not all bubbles took part in the growth process at these temperatures and gas resolution was not an operative process. Under conditions of high vacancy concentration, the bubbles developed major (111) type faces and minor (100) type faces and denuded zones surrounded grain boundaries. (auth)

Ceramics and Cermets

Refer also to abstracts 25076, 25077, 25210–25212, 25631–25635, 25665, and 26033.

25761 (BMI–1823) DEVELOPMENT OF ADVANCED HIGH-TEMPERATURE NUCLEAR MATERIALS DURING AUGUST–OCTOBER 1967. Keller, Donald L.; Chubb, Walston (Battelle Memorial Inst., Columbus, Ohio). 1 Nov 1967. Contract W-7405-eng-92. 86p. Dep. CFSTI.

Specimens of UC, UN, and tungsten cermets containing UC, UN, and UO_2 were irradiated at temperatures near 1750°C to burnups ranging up to 2.8×10^{20} fissions per cm^3. Volume increases of 20 to 40% are observed for all of these fuels at burnups near 1×10^{20}

fissions per cm^3; however, the rate of volume increase is much lower or ceases altogether at higher exposures. The volumetric swelling rates of the bulk fuels are nearly identical to those of their corresponding cermets. The UO_2 cermets show a tendency for vapor transport and redistribution of UO_2 within their claddings. The UC-base fuels show a tendency for cladding failures probably caused by reaction between carbon in the fuel and oxide impurities in the tungsten–rhenium claddings. The UN-base fuels have no such faults and tend to show the lowest swelling rates. Preliminary results obtained on UC and UN at a burnup of 1.4×10^{20} fissions per cm^3 suggest that an axial hole 55 mils in diameter does not improve the swelling behavior of UC but does improve the swelling behavior of UN. A 110-mil hole in UC appears to be detrimental to its behavior. Two UC-copper cermets remain intact after one cycle of irradiation at about 1500°C. A potential problem with using liquid metals possessing high vapor pressures as heat-transfer media has been identified and a potential solution is suggested. It is demonstrated that under near boiling conditions voids in a liquid-metal column tend to collect at the point of maximum temperature so as to equalize vapor pressures at both ends of the void. A capillary pump such as is used in a heat pipe is suggested as a solution to the problem in this particular instance. Evaluation results using mechanical model of the swelling behavior of nuclear fuels have indicated that the observed saturation of swelling of fuels at a volume increase of 20 to 40% at 1700°C may be related to a rapid increase in gas release rates as porosity increases to these levels. (auth)

25762 (BMI-1839) DEVELOPMENTS IN THE TECHNOLOGY OF NUCLEAR FUELS DURING FEBRUARY–APRIL 1968. Keller, Donald L.; Chubb, Walston (Battelle Memorial Inst., Columbus, Ohio). 1 May 1968. Contract W-7405-eng-92. 106p. Dep. CFSTI.

At a burnup of 2.0×10^{20} fissions per cm^3 at about 1700°C, a 0.110-in. axial centerline hole in otherwise dense UC was definitely detrimental compared to the behavior of UC containing no hole or to UC specimens containing 0.055-in. axial holes. All specimens were designed to produce the same surface heat flux; examination of a model for the behavior of these specimens suggests that the observed behavior is correct if there is essentially no restraint from the cladding and if essentially no gas is released from the UC. Under these circumstances, the gas bubbles should swell the UC as if it were expanding from thermal expansion with a temperature rise. The specimens with the larger hole contain the same total amount of fission gas in a smaller volume of fuel; hence, they expand more. At a burnup of 1.5×10^{20} fissions per cm^3 94% dense, bulk UO_2 specimens with 0.110-in. axial centerline holes continue to swell about twice as fast as 97% dense, bulk UO_2 specimens with metal vent tubes at the axis. All these specimens have essentially the same internal gas-plenum volume and none are intentionally vented to the capsule. The temperature of these specimens has dropped from about 1700 to about 1500°C. At a burnup of 0.94×10^{20} fissions per cm^3 at about 1650°C, two 30 vol % tungsten–42 vol % UO_2–28 vol % porosity cermets in 0.040-in.-thick claddings have demonstrated a diametral swelling of less than 2%. This is in good agreement with the behavior of a 94% dense cermet which showed saturation of swelling after a volume increase of about 30% at a burnup of about 1.5×10^{20} fissions per cm^3. However, one of these two specimens is vented to the capsule, and since the vented specimen is swelling as much or more than the other, it is clear that the vent is superfluous in addition to a gas plenum. Microstructures which are believed to show the transformation of cubic U_2N_3 to hexagonal U_2N_3 are presented. The latter is approximately 11% denser than the former; therefore, if hexagonal U_2N_3 forms during the initial compaction of UN–U_2N_3 mixtures, the porosity that can be developed by subsequent decomposition of the U_2N_3 to UN is reduced. Additions of up to 25 mole % UO to UC apparently raise the peritectic reaction temperature of tungsten and UC from approximately 2150 to some temperature above 2200°C. Parametric variations of the mechanical model which was extended to include gas release and loss of mechanical strength of the fuel during irradiation indicate that gas release dominates the amount of swelling predicted by the model. Studies of release of gas from UC containing the gas in metastable solution are being compared with the release of gas from UC in which the gas has been precipitated by annealing at high temperatures. A fifteenfold decrease in rates of gas release between these two conditions at an exposure of 1.1×10^{13} fissions per cm^3 suggests that the anneal is precipitating most of the gas and that, therefore, the equilibrium solubility of fission gas in UC is very much less than 10^{13} atoms per cm^3. (auth)

Corrosion and Erosion

Refer also to abstracts 25641 and 25647.

25763 (GEMP-731) PHYSICAL–CHEMICAL STUDIES OF CLAD UO_2 UNDER REACTOR ACCIDENT CONDITIONS. Juenke, E. F.; White, J. F. (General Electric Co., Cincinnati, Ohio. Nuclear Systems Programs). Apr 1970. Contract AT(40-1)-2847. 66p. Dep. CFSTI.

The behavior of Zircaloy-clad UO_2 and 304L stainless steel clad fuel elements in steam and in steam-air mixtures from 1000°C to the melting point of UO_2 was investigated. Results of dynamic (i.e., transient temperature) testing to determine combined effects of internal pressure, heating rate, and atmosphere on the deformation and failure behavior of Zircaloy cladding materials are reported. Similar studies were conducted on 304L stainless steel. Tensile strength and ductility measurements were made on oxidized Zircaloy-4. Modifications and check-out of apparatus for testing irradiated tubes under dynamic conditions were accomplished to accommodate tubes of smaller dimensions than those previously tested and to provide fixturing for testing in a steam atmosphere. Studies on the phase relationships and melting behavior in the UO_2–Zr pseudobinary system were continued. The effects of dynamic heating on the annealing of irradiation induced defects in Zircaloy-2 cladding from Dresden I were evaluated by electron microscope examination. (auth)

25764 (WAPD-TM-909) CORROSION OF OXIDE NUCLEAR FUELS IN HIGH-TEMPERATURE WATER (LWBR DEVELOPMENT PROGRAM). Markowitz, J. M.; Clayton, J. C. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Feb 1970. Contract AT-(11-1)-Gen-14. 56p. Dep. CFSTI.

The corrosion behavior of a group of nuclear fuel oxides including urania, thoria, urania-zirconia, urania-calcia-zirconia, and urania-thoria has been studied in 360°C, pH 10 flowing water, both degassed and oxygenated (5 and 100 ppM). Weight gains of the specimens, which were of plate or cylindrical pellet shape, were determined periodically during the corrosion exposures, some of which were as long as 500 days; in addition, ceramographic examinations, x-ray diffraction measurements, and chemical analyses were carried out on selected specimens. The results are summarized and discussed. (auth)

25765 THE THERMAL DECOMPOSITION OF SURFACE OXIDES FORMED ON GRAPHON. Phillips, Roger; Vastola, F. J.; Walker, P. L. Jr. (Pennsylvania State Univ., University Park). Carbon; 8: 197-203(Mar 1970).

The thermal decomposition of surface oxides formed during the low pressure oxidation of Graphon was studied. Oxidation reactions were performed at 525, 575, and 625°C in a static reactor, using initial O_2 pressures between 10 and 200 mtorr. The amount of surface oxide formed was found to increase with decreasing reaction temperature and increasing initial O_2 pressure. The surface oxides were decomposed by raising the temperature at 3°C per min up to 950°C in a closed system and measuring the partial pressures of the CO and CO_2 produced at frequent intervals. Each graph of accumulated CO against temperature consisted of a series of intersecting linear portions, suggesting that desorption was taking place from a number of discrete types of sites. The accumulated CO_2 measured was found to pass through a maximum at about 700°C, after which the partial pressure decreased due to the reaction of CO_2 with the Graphon surface. The rate of this secondary reaction was found to be strongly dependent on the rate of decomposition of the surface oxide, and it is suggested that decomposition of surface oxide leaves highly reactive "nascent" sites on the Graphon surface at which CO_2 can react. (auth) (UK)

25766 EFFECT OF RADIOLYTIC OXIDATION ON THE PHYSICAL PROPERTIES OF GRAPHITE. Brocklehurst, J. E.; Brown, R. G.; Gilchrist, K. E.; Labaton, V. Y. (United Kingdom Atomic Energy Authority, Culcheth, Eng.). J. Nucl. Mater.; 35: 183-94(May 1970).

Isotropic graphites of the type to be used as the moderator in Advanced Gas-Cooled Reactors were radiolytically oxidized in CO_2 to very high weight losses well beyond those which will occur in practice, in rigs in the BR-2 and DIDO reactors, for which γ-flux levels differ by a factor of 20. The effect of weight loss on the physical properties of these specimens was determined after thermal annealing of the radioinduced component of property change. At the maximum, weight loss of about 37% decreases in thermal conductivity, Young's modulus, and strength by factors of 3, 6, and 8 respectively were observed, and there was no effect of the γ-flux level. The factorial changes in these parameters were similar for all the different graphites examined. For design purposes it is shown that property changes produced by radiolytic oxidation are separable from those induced by fast neutron irradiation within an error of about 10%. The data are discussed in terms of available models for the properties of porous materials. (auth)

Preparation and Fabrication

25767 (ANL–7417, pp 23) NUCLEAR SAFETY. (Argonne National Lab., Ill.).

Fabrication procedures for PuO_2-UO_2 fuel rods to be used in TREAT fuel meltdown studies are described. (J.R.D.)

25768 (ANL–7417, pp 25-36) DEVELOPMENT OF CERAMIC FUELS. (Argonne National Lab., Ill.).

Research and development progress is reported on thermal stability of Pu ceramics, systems incorporating U and mixed anions, properties of compounds of actinides and group IV-VI elements, structure and properties of advanced fuels, and irradiation behavior of advanced ceramic materials. (J.R.D.)

25769 (WARD–3791-43) THE DESIGN AND FABRICATION OF SODIUM-BONDED (U, Pu)C FUEL PINS FOR TESTING IN EBR-II. Biancheria, A.; Boltax, A.; Harbourne, B. L.; Jacoby, W. R. (Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.). Feb 1970. Contract AT(30-1)-3791. 63p. Dep. CFSTI.

Activities in a program to evaluate problems associated with development of swelling accommodation in PUC–UC fuel elements are reported. Other aspects investigated include fuel-clad reactions and sodium bond behavior. Information is presented in sections on pin and capsule design analysis, fuel fabrication, fuel characterization, fuel pin fabrication, and capsule fabrication and assembly. (J.R.D.)

25770 IMPROVEMENTS IN AND RELATING TO NUCLEAR REACTOR FUEL MATERIAL. Davis, Fred Weymouth (to Babcock and Wilcox Co.). British Patent 1,187,244. 8 Apr 1970. Priority date 1 Apr 1966, United States.

A process is described for preparing particle-form nuclear fuel material of fertile, fissile, and burnable poison components, which includes forming a colloidal solution of fertile material, converting the solution to gel particles, and calcining the gel particles to convert them to densified fuel particles. The material is treated at an earlier stage than that of the final densified form with fissile materials that are taken up and result in the fissile and burnable poison components of the final particles. (J.C.W.)

25771 IMPROVEMENTS IN THE PREPARATION OF NUCLEAR REACTOR FUEL MATERIALS. Halva, Carroll Joe; Dewell, Edgar Harrison (to Babcock and Wilcox Co.). British Patent 1,187,243. 8 Apr 1970. Priority date 1 Apr 1966, United States.

A process is described for preparing particulate nuclear fuel material of fissile and fertile oxides by producing gel particles incorporating the oxides and calcining the gel particles to form the fuel material. The method for producing gel particles of less irregular shapes is termed the modified sol-gel process. (J.C.W.)

25772 DISLOCATION ETCHANT FOR SINGLE-CRYSTAL Y_2O_3. Brower, W. S. Jr.; Farabaugh, E. N. (National Bureau of Standards, Washington, D. C.). J. Amer. Ceram. Soc.; 53: 225 (21 Apr 1970).

A chemical etching method, used to reveal dislocations in monocrystalline Y_2O_3, is described. Samples with cleaved or chemically polished surfaces were etched in a constant-boiling solution of HCl in water for 3 to 5 min. (G.M.C.)

25773 METHOD FOR FORMING FINE AND UNIFORM DISPERSION OF THORIUM DIOXIDE IN TUNGSTEN POWDER. Cerulli, Nicholas F. (to Westinghouse Electric Corp.). U. S. Patent 3,505,059. 7 Apr 1970. Filed 30 Sep 1966.

Methods of incorporating fine dispersions of ThO_2 in W metallic powders are described. The dispersion is prepared by heating powders of WO_3 and Th metal in hydrogen at 950 to 1200°C until the WO_3 is reduced to W and the Th is converted to ThO_2. The resulting cermet is useful in lamp filaments and high temperature structural members. (J.R.D.)

25774 METHOD OF JOINING BERYLLIA TO ANOTHER CERAMIC BODY. Nuding, James M. (to U. S. Atomic Energy Commission). U. S. Patent 3,505,138. 7 Apr 1970. Filed 7 Mar 1960.

A method of bonding BeO to Al_2O_3 effecting a strong high-temperature bond is described. The bond is made using aqueous aluminum oxide powder paste in contact with the ceramic surfaces at 1650 to 1900°C until the joint is formed, then slowly cooling the members to ambient atmospheric temperature. The heating cycle is conducted using a neutral environment. (J.R.D.)

25775 IMPROVEMENTS IN OR RELATING TO GLASSES. (to Ernst Leitz GmbH). British Patent 1,183,684. 11 Mar 1970. Priority date 29 Aug 1967, Germany.

Methods of preparing shielding-type glasses are described. The glasses are prepared by melting mixtures of 15 to 26 wt % Li_2O_3, 0 to 10 wt % BeO, 60 to 78 wt % B_2O_3, and 1 to 17 wt % WO_3. Sm_2O_3 may be added optionally in place of part of the WO_3. (J.R.D.)

25776 PREPARATION OF MICRON-SIZED $^{238}PuO_2$. Doty, J. W.; Chong, C. H. H. (Mound Lab., Miamisburg, Ohio). Contract AT(33-1)-Gen-53. J. Nucl. Mater.; 35: 247-9(May 1970).

A method was devised for the preparation of micron-sized $^{238}PuO_2$. A solution of plutonium(III) nitrate was added to an oxalic acid solution to precipitate plutonium(III) oxalate for further processing. Plutonium-238 dioxide was obtained as a decomposition product of the oxalate. (G.M.C.)

Properties Evaluations

Refer also to abstracts 25099, 25674, 25681, 25703, 25716, 26320, and 26835.

25777 (CEA-CONF-1490) INTERNAL FRICTION OF CARBONS AND GRAPHITES. Gobin, P.; Merlin, J.; Rouby, D. (Institut National des Sciences Appliquees, Lyon (France)); Jouquet, G.; Rappeneau, J. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). [1970]. 18p. (In French). (CONF-700407–1). Dep. CFSTI (U. S. Sales Only).

From 3rd International Conference on Industrial Carbon and Graphite, London, England.

The coefficient of internal friction was measured on a range of carbon materials, with a torsion pendulum at frequencies around 1 cps. Its evolution was determined for a strain extent from 10^{-5} to 2.10^{-3}, in the temperature range −180 to 500°C. Two main processes of energy absorption can be distinguished as a continuous background which can be connected to strain by a hyperbolic relationship and is slightly increased with temperature and a peak around 0°C, which appears to be a hysteresis peak and is analyzed by the Granato–Lücke model. The following conditions induce changes in these two components: graphitization process, neutron irradiation, annealing, thermomechanical treatments. The level of the continuous background rises with the degree of graphitization; it is reduced by low neutron doses. The higher the amplitude of the peak, the lower the degree of graphitization. The amplitude decreases with irradiation and the peak moves toward higher temperatures. Several mechanisms can be taken into account: dislocation motions, interactions between dislocations and point defects and between microcracks and point defects. (auth) (France)

25778 (GEMP–735) MELTING POINT OF PURE ZIRCONIA. Latta, R. E.; Duderstadt, E. C. (General Electric Co., Cincinnati, Ohio. Nuclear Systems Programs). Apr 1970. Contract AT(40-1)-2847. 5p. Dep. CFSTI.

Data are presented as the basis for assuming that the upper thermal arrest is indicative of the melting point of stoichiometric ZrO_2. The value 2680°C is assigned an uncertainty of not greater than ±15°C. (J.R.D.)

25779 (GEMP–736) MELTING POINT AND PHASE TRANSFORMATION OF BERYLLIUM OXIDE. Latta, R. E.; Duderstadt, E. C.; Fryxell, R. E. (General Electric Co., Cincinnati, Ohio. Nuclear Systems Programs). Apr 1970. Contract AT(40-1)-2847. 4p. Dep. CFSTI.

Using a thermal arrest method, a melting point of 2430 ± 10°C was obtained for BeO. In addition, the $\alpha-\beta$ transformation was observed at 2095°C (heating) and 2058°C (cooling) during a single cycle. (G.M.C.)

25780 (ORNL–TM–2915) THERMAL CONDUCTIVITY OF Cm_2O_3. Ketchen, E. E. (Oak Ridge National Lab., Tenn.). Apr 1970. Contract W-7405-eng-26. 20p. Dep. CFSTI.

The thermal conductivity of $^{244}Cm_2O_3$ has been measured at 500 to 1100°C by an absolute method in which an accurately known quantity of heat which is produced by alpha decay of ^{244}Cm flows longitudinally through the sample. (auth)

25781 (SU-326-P-25-10) THERMODYNAMIC PROPERTIES AND DEFECT STRUCTURE OF INTERMETALLIC COMPOUNDS. Final Report, May 1, 1959–December 31, 1969. Stevenson, David A. (Stanford Univ., Calif. Dept. of Materials Science). Mar 1970. Contract AT(04-3)-326. 80p. Dep. CFSTI.

Electrical and optical measurements were made on as-grown, Zn-annealed, and Te-annealed undoped and aluminum doped ZnTe. These measurements helped to clarify the defect levels in ZnTe crystals. Electric conductivity and Hall-effect measurements were made as a function of temperature on undoped ZnTe crystals. Aluminum doped crystals, in which the Fermi level was shifted toward the center of the band gap, were studied for the purpose of investigating defect levels other than those normally observed in low resistivity ZnTe. A study was also made on self diffusion of ZnSe under variable component partial pressure and impurity content. The diffusion and solubility of antimony in zinc selenide was studied. The influence of component pressure on the electrical properties of CdSe at high temperatures was investigated. Measurements were made on single crystals that were grown from the congruent melt using a vertical Bridgman technique. Since the properties of these compounds are sensitive to native and impurity defects, careful preparation of crystals was an essential starting point. (J.C.W.)

25782 (WAPD-TM-901) IN-PILE AND UNIRRADIATED THERMAL CONDUCTIVITY OF A SINGLE-FIRED ThO_2 + 10 w/o UO_2. LWBR Development Program. Jacobs, D. C. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Feb 1970. Contract AT(11-1)-Gen-14. 30p. Dep. CFSTI.

The in-pile and unirradiated thermal conductivities of a single-fired ThO_2 + 10 wt % UO_2 fuel were determined. The in-pile data were obtained at $300 \leq T \leq 900°C$ to a burnup 2.6×10^{17} fissions/cm^3. The test results showed that there is no apparent difference between the in-pile and unirradiated thermal conductivities. The conductivities of the single-fired material were compared with those of a double-fired ThO_2 + 10 w/o UO_2 of comparable density. The double-fired material had relatively small grains and small, uniformly distributed pores as compared with the large grains and "necklace" porosity of the single-fired fuel. The comparison of these data showed that the conductivities of the two fuels are significantly different; the curve for single-fired fuel achieves higher conductivity values than the double-fired fuel at temperatures greater than 1000°C. This difference is attributed to the differences in structure between the two materials. (auth)

25783 THERMODYNAMIC BEHAVIOR OF DILUTE SOLUTIONS OF HYDROGEN IN NIOBIUM. McQuillan, A. D.; Wallbank, A. D. (Univ. of Birmingham, Eng.). J. Chem. Phys.; 52: 965-9(15 Jan 1970).

In a recent paper on the thermodynamic properties of dilute solutions of hydrogen and deuterium in β-titanium and β-zirconium anomalous behavior was observed. It was concluded that a similar investigation on the niobium–hydrogen system might well provide a better insight into this phenomenon, should it prove to exist in the system, because the temperature range of dilute hydrogen solubility in the body-centered cubic structure of the niobium–hydrogen system is much more extensive than in the corresponding titanium and zirconium systems. It was shown that departures from Sievert's law were present in dilute hydrogen solutions in niobium. Departures from random solution were well marked and proved to have a strong temperature dependence. An analysis of the thermodynamic behavior of the niobium–hydrogen system together with some results on the niobium–deuterium system would seem to indicate that a small degree of clustering is present in such dilute alloys. (auth)

25784 A DETERMINATION OF THE THERMODYNAMIC DATA OF THE BORIDES Mo_2B, W_2B, AND Re_3B. Baehren, F. D.; Vollath, D. (Kernforschungszentrums, Karlsruhe, Ger. Univ., Karlsruhe, Ger.). Planseeber. Pulvermet.; 17: 180-3 (Oct 1969). (In German).

Thermodynamic data for Mo_2B, W_2B, and Re_3B were determined from the initial point of the reaction between the boron nitride and the metal powder $x\,Me + y\,BN = M3_xB_y + \frac{1}{2}N_2$ at varying definite nitrogen partial pressures. The temperature of the reaction initiation was determined as a function of the nitrogen partial pressure. The reaction enthalpies, free reaction enthalpies, formation enthalpy, and free formation enthalpy were calculated for each of the borides from the experimental data. (J.S.R.)

25785 ENTHALPY OF FORMATION OF SILICON CARBIDE BY FLUORINE BOMB CALORIMETRY. Greenberg, Elliott; Natke, Carol A.; Hubbard, Ward N. (Argonne National Lab., Ill.). J. Chem. Thermodyn.; 2: 193-201(Mar 1970).

The energy of combustion of silicon carbide in fluorine was measured with samples of both hexagonal and cubic crystalline modifications. The standard enthalpies of formation ΔH_f^0(298.15 K) of the α (hexagonal) form and the β (cubic) form of silicon carbide were calculated to be (−17.23 ± 0.46) and (−17.49 ± 0.43) kcal $mole^{-1}$, respectively. (auth) (UK)

25786 FATIGUE BEHAVIOR OF A HIGH-DENSITY GRAPHITE AND GENERAL DESIGN CORRELATION. Leichter, H. L.; Robinson, E. (Univ. of California, Livermore). J. Amer. Ceram. Soc.; 53: 197-204(21 Apr 1970).

The fatigue behavior of a high-density graphite was investigated in reverse bending up to 5×10^8 cycles at room temperature. Fatigue life was analyzed statistically, using a Weibull distribution and a homologous stress. The homologous stress is the ratio of applied stress in fatigue to the expected first-cycle strength. The first-cycle strength was calculated from bending tests of similar materials or mate specimens, using the Weibull statistical strength theory to correct for the significant size effect. Homologous stress gave an essentially invariant fatigue correlation for many graphite grades and might be used to estimate fatigue life under a wide variety of operating conditions. The practical endurance limit for graphite corresponded to a homologous stress of about 47%. (auth)

25787 ELASTIC AND ANELASTIC RESPONSE OF POLYCRYSTALLINE UO_2–PuO_2. Nutt, A. W. Jr. (Univ. of Illinois, Urbana); Allen, A. W.; Handwerk, J. H. J. Amer. Ceram. Soc.; 53: 205-10(21 Apr 1970).

A sonic resonance technique was used to investigate the room-temperature elastic and anelastic properties of physically mixed $U_{0.8}Pu_{0.2}O_2$ as a function of density, stoichiometry, and cation homogeneity. The effect of porosity on the elastic moduli was linear and is described by $E = 2102.7\ (1 - 2.03P) \pm 13.5$ kbars for the Young's modulus, $G = 823.5\ (1 - 2.05P) \pm 9.1$ kbars for the shear modulus, and $B = 1584.8\ (1 - 1.89P) \pm 59.1$ kbars for the bulk modulus, where P is the volume fraction porosity. Poisson's ratio was 0.28 and was not a function of porosity. The Debye temperature of $U_{0.8}Pu_{0.2}O_2$ computed from the Young's and shear moduli for theoretically dense specimens was 379°K. Variation of the O/M ratio from 1.968 to 2.006 produced no significant change in either the damping capacity or the elastic moduli of single-phase 80% UO_2-20% PuO_2 solid solutions. An approximate 24% decrease of the room-temperature Young's and shear moduli and an approximate increase by a factor of 14 in the internal friction were observed with gross modifications of plutonium cation homogeneity. Preliminary results suggest that internal friction measurements might be used to assay the homogeneity of UO_2–PuO_2 solid solutions. (auth)

25788 CARBON FIBERS. Com. Naz. Energ. Nucl., Notiz.; 16: No. 2, 66-9(Feb 1970). (In Italian).

Summaries are presented on research completed and in progress concerning carbon fibers and their possible uses in various sectors of technology, in particular in uranium enrichment processes by gaseous centrifugation (rotating drum processes). (tr-auth)

25789 THE EXCHANGE OF U^{4+} AND Th^{4+} BETWEEN MOLTEN LiF–BeF_2–ThF_4–UF_4 AND $(U$–$Th)O_2$ SOLID SOLUTIONS. Bamberger, C. E.; Baes, C. F. Jr. (Oak Ridge National Lab., Tenn.). J. Nucl. Mater.; 35: 177-82(May 1970).

The exchange of uranium and thorium between $LiF-BeF_2-ThF_4$ melts and $(U-Th)O_2$ solid solutions was relevant to the oxide chemistry of Molten Salt Breeder Reactor fuel, to the thermodynamics of UO_2-ThO_2 solid solutions, and to a two-phase solvent extraction system in reprocessing reactor fuels. Exchange equilibrium at 580 to 780°C usually was obtained after 40 to 120 hr of vigorous stirring of the two phases. The equilibrium quotient of mole fractions, $Q = (X_{UO_2}X_{ThF_4})/(X_{UF_4}X_{ThO_2})$, was determined at various compositions of the oxide phase and of the fluoride phase and at different temperatures. The results obtained for 72-16-12 mole % $LiF-BeF_2-ThF_4$ were fitted by least squares to an equation containing only two parameters: $\log_{10} Q = (2101 + 550\,X_{UO_2})/T$. Other results indicated that Q did not vary over a fairly wide range of composition of the fluoride phase. The expression for Q gives for the oxide solid solution $\log_{10} \gamma_{UO_2} = (275/T)X^2_{ThO_2}$ and $\log_{10} \gamma_{ThO_2} = (275\ T)X^2_{UO_2}$, and for the heat of mixing $(\Delta H_m)_{0.5} = 315$ cal/mole. (auth)

25790 DETERMINATION OF SOLIDUS-LIQUIDUS TEMPERATURES IN THE UO_{2+x} SYSTEM $(-0.50 < x < 0.20)$. Latta, R. E.; Fryxell, R. E. (General Electric Co., Cincinnati). Contract AT(40-1)-2847. J. Nucl. Mater.; 35: 195-210(May 1970).

Solidus and liquidus temperatures for urania were determined to ± 15°C over the composition range $UO_{1.50}$ to $UO_{2.23}$. The congruent composition was $UO_{2.00}$ (2865°C) and the monotectic composition was $UO_{1.46}$ (2425°C). Data were obtained by a thermal arrest technique, using samples sealed in tungsten or rhenium. The absolute accuracy of the temperature measurements was verified by melting Ta, Mo, and Al_2O_3 (sapphire) as standards. For oxygen-excess compositions, data for W-contained and Re-contained samples agreed well in spite of the extremely different types of interaction in the two systems. Rhenium dissolved in molten UO_{2+x} and separated out as the element on cooling with no net change in the urania. Tungsten dissolved in the melt and separated out during cooling as a mixture of W and U_xWO_3. The remaining urania was stoichiometric. (auth)

Structure and Phase Studies

Refer also to abstracts 25724 and 25736.

25791 (AD–700765) THERMODYNAMIC PROPERTIES OF TERNARY REFRACTORY CARBIDES. I. ZIRCONIUM–NIOBIUM–CARBON. Technical Report, July 1, 1967–June 30, 1969. Jun, C. K.; Hoch, M. (Cincinnati Univ., Ohio). Dec 1969. Contract F33615-67-C-1565. 40p. (AFML–TR–69-209(Pt.1)). CFSTI.

The nonstoichiometry of zirconium–niobium–carbide with the sodium–chloride type structure, Zr (x)Nb (1 – x)C (y), was studied by measuring the activities of the components as a function of composition. The samples were prepared by heating the required amounts of oxides and graphite in a high-vacuum induction furnace. Lattice parameters were measured of all specimens. At constant carbon concentration (y = constant), the lattice parameter deviates from Vegard's law at the niobium-rich end. The metal–metal interaction energy is not much different from that in the bcc metallic zirconium–niobium system. The difference between the zirconium–carbon and niobium–carbon interaction energies (E (13)-E (23)) is linearly dependent on composition. (auth) (USGRDR)

25792 (GEMP–733) PREPARATION AND CRYSTAL STRUCTURE OF $NaUO_3$ AND $Na_{11}U_5O_{16}$. Bartram, S. F.; Fryxell, R. E. (General Electric Co., Cincinnati, Ohio. Nuclear Systems Programs). Apr 1970. Contract AT(40-1)-2847. 10p. Dep. CFSTI.

Samples of $NaUO_3$ and $Na_{11}U_5O_{16}$ were prepared by reacting mixtures of Na_2CO_3 with UO_2 at various mole ratios in an argon atmosphere at temperatures ranging from 700°C for 160 hours to 1000°C for 16 hours. The crystal structure of $NaUO_3$ was verified by x-ray intensity measurements obtained from a well-annealed single phase sample. Accurate determination of the orthorhombic lattice parameters for $NaUO_3$ from twenty-five resolved back-reflection lines gave $a_0 = 5.776$ Å, $b_0 = 5.910$ Å, and $c_0 = 8.282$ Å (±0.001 Å). The results showed that the proposed structure must be essentially correct, although the x-ray intensities were not very sensitive to the Na and O positional parameters. A second complex oxide was observed in reaction products having a Na : U mole ratio greater than 1.0. Calculated and observed results identified the oxide as $Na_{11}U_5O_{16}$. X-ray data are tabulated. (J.C.W.)

25793 STUDY OF FILLED Ti_2Ni-TYPE PHASES WITH HAFNIUM, TANTALUM, AND TUNGSTEN. Kotyk, M. (Army Research Office, Durham, N. C.); Stadelmaier, H. H. Met. Trans.; 1: 899-903(Apr 1970).

Filled Ti_2Ni type (η) phases were reported in the past and presumed to exist in the systems Hf–Ni–O, Ta–Ni–O, and W–Ni–O. An investigation of 1000°C isothermal sections in these three systems showed that only the Hf–Ni oxide was stable. It had an Hf-to-Ni ratio of 2 : 1 and an oxygen content of 4 to 8 at.%. Its lattice constant varied from 12.135 to 12.108Å and decreased with increasing nickel content. In Ta–Ni–O and W–Ni–O the η phase was stabilized when nitrogen was accidentally picked up during sample preparation. The systems Fe–W–O and Co–W–O, which were reported to have η oxides, only show binary phases at 1000°C. New phases found in this investigation are $\sim Hf_4Ni_2N$ with the η carbide structure, and $Hf_{74}Ni_{24}O_2$ and $Hf_{74}Ni_{24}N_2$ of identical but unknown structure. (auth)

25794 THE ETA CARBIDES IN THE Fe–W–C AND Co–W–C SYSTEMS. Pollock, C. B. (Oak Ridge National Lab., Tenn.); Stadelmaier, H. H. Met. Trans.; 1: 767-70(Apr 1970).

The η carbides in Fe–W–C were Fe_6W_6C with an edge length of the cubic unit cell a = 10.956 to 10.958Å and Fe_3W_3C with a = 11.102 to 11.146Å. In Co–W–C the η carbides solidified from the melt as Co_6W_6C and $\sim Co_2W_4C$. Co_6W_6C retained a narrow homogeneity range down to 1000°C with an observed range of lattice constants between 10.894 and 10.902 Å. The compositional range of Co_2W_4C spread out between Co_3W_3C and Co_2W_4C at 1400°C and narrowed back down to a small range around Co_2W_4C at 1000°C. Its lattice constants varied between 11.066 and 11.251 Å. In Fe–W–C a new hexagonal phase was found at FeW_3C. It has the structure reported Schönberg for $Co_3W_9C_4$ and its lattice parameters are a = c = 7.806 to 7.810 Å. (auth)

25795 ON THE CRYSTAL CHEMISTRY OF THE CLOSE PACKED TRANSITION METAL CARBIDES. I. THE CRYSTAL STRUCTURE OF THE ζ-V, Nb, AND Ta CARBIDES. Yvon, K.; Parthe, E. (Univ. of Pennsylvania, Philadelphia). Acta Crystallogr., Sect. B; 26: 149-53(1970).

The crystal structure of V_4C_3 was solved by single-crystal diffraction methods. The trigonal structure consists of 12 close packed metal atom layers with stacking sequence $(hhcc)_3$ or ABABCACABCBC. The carbon atoms that occupy octahedral interstices were not ordered in the single crystal examined. The other carbides Nb_4C_3 and Ta_4C_3 have the same metal atom arrangement. Due to the small scattering power of the C atoms no statement can be made on the C atom order in these compounds. The structure of the ζ-phase with ordered C atoms is isotypic with Sn_4P_3. (auth) (Denmark)

25796 LATTICE PARAMETERS, THERMAL EXPANSION COEFFICIENTS, AND DENSITIES OF Nb, AND OF SOLID SOLUTIONS Nb–O AND Nb–N–O AND THEIR DEFECT STRUCTURE. Straumanis, M. E.; Zyszczynski, S. (Univ. of Missouri, Rolla). J. Appl. Crystallogr.; 3: 1-(1970).

The temperature expansivities (by the x-ray method), the densities, and the defect structures of the 3 cubic nonstoichiometric compounds (solid solutions) of the composition Nb, $NbO_{0.017}$, and $NbN_{0.90}O_{0.013}$ (nitride) were determined. The lattice parameters a at 25°C were: 3.3004, 3.3047, and 4.3855 Å; the linear expansion coefficients, α, between 15 and 65°C were 7.6, 8.65, and 7.75 × 10^{-6}°C^{-1}, respectively. As the temperature was increased, α underwent several changes in magnitude. The cubic nitride started to decompose at about 850°C, with a loss of N (decrease of a). The structure of the oxygen-poor Nb was free from vacancies and interstitial atoms within the limits of error; that of the oxygen-rich Nb contains interstitial atoms on additional sites in a concentration of 1.9%, and the nitride contains vacant sites in both sublattices (4.8% total). (auth) (Denmark)

25797 ON THE CRYSTAL CHEMISTRY OF THE CLOSED PACKED TRANSITION METAL CARBIDES. II. A PROPOSAL FOR THE NOTATION OF THE DIFFERENT CRYSTAL STRUCTURES. Parthe, E.; Yvon, K. (Univ. of Pennsylvania, Philadelphia). Acta Crystallogr., Sect. B; 26: 153-63(1970).

To counteract the prevailing confusion in the notation of the close packed transition metal carbides a notation is proposed that is based on the structural features of the carbide phases. It consists of the Jagodzinski–Wyckoff symbol for the stacking sequence of the close packed metal atom layers followed by the space group of the compound to distinguish between different arrangements of the carbon atoms on the octahedral interstices. The known close packed carbide types are reviewed and their new notation is given. It is found that in the case of the NaCl defect structures there exist two different structure types that although not homometric yet give rise to identical powder diffraction patterns. A distinction between both types in principle is possible only with single-crystal diffraction data. (auth) (Denmark)

25798 ELECTRON MICROSCOPIC STUDY OF THE MIXED OXIDE $(W_{0.35}V_{0.65})_2O_5$. Van Landuyt, J.; Vochten, R.; Amelinckx, S. (Univ., Antwerp. SCK-CEN, Mol, Belg.). Mater. Res. Bull.; 5: 275-80(Apr 1970).

The mixed oxide $(W_{0.35}V_{0.65})_2O_5$ was studied by electron microscopy and electron diffraction. The structure of this oxide can be derived from the basic ReO_3 structure by a double shear mechanism. The two sets of shear planes could be directly resolved; this observation is in complete agreement with the model proposed by Israelson and Kihlborg. Also the relative intensity of the electron diffraction spots gives direct support to the interpretation of this structure as a shear structure. (auth)

25799 X-RAY INVESTIGATION OF THE U_3O_8–V_2O_5 SYSTEM. Herak, Rajna M.; Manojlovic, Ljubica M. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). Bull. Soc. Chim. Beograd; 33: 219-25(1968).

New phases were determined in mixed U_3O_8 + V_2O_5 heated in air at 450, 650, 850, and 1100°C. Phase analysis was carried out by x-ray powder method. $UVO_{5.5}$ appeared in the mixture with U : V ratios 6 : 1 to 1 : 1, UV_2O_8 in the mixture 1 : 1–1 : 4, and $UV_3O_{10.5}$ in the mixture 1 : 1–1 : 6. An orthorhombic cell with a = 13.19 Å, b = 12.03 Å, and c = 16.97 Å was determined on which a powder pattern of the $UVO_{5.5}$ was indexed. This phase decomposed at 1100°C. It was shown that UV_2O_8 had the same powder pattern as α-$(UO_2)_2V_6O_{17}$ compound. (auth)

25800 INFLUENCE OF THE INCORPORATION OF ^{228}Th ON THE STRUCTURAL AND ELECTRONIC PROPERTIES OF THORIA. Beaumont, Maurice; Claudel, Bernard; Mentzen, Bernard (Institut National des Sciences Appliquees, Lyon). J. Inorg. Nucl. Chem.; 32: 165-72(Apr 1970). (In French).

Possible modifications in the structural and electronic properties of thoria caused by incorporation of ^{228}Th were investigated. Several methods were used (X-ray diffraction, i.r. and u.v. absorption, measuring electrical conductivity of powders, E.S.R.). The results were in agreement with the existence of at least two kinds of defects. (tr-auth)

25801 THE ROLE OF METALLOGRAPHY IN THE CHARACTERIZATION OF MODIFIED AND UNMODIFIED (U,Pu)C POTENTIAL FAST REACTOR FUELS. French, P. M.; Hodge, M. H.; Jacoby, W. R.; Shalek, P. D. (Westinghouse Electric Corp., Cheswick, Pa.). pp 99-108 of Proceedings of Second Annual Technical Meeting, International Metallographic Society, Inc., September 8–10, 1969, San Francisco, California. /Bender,

J. H. (ed.). Los Alamos, N. Mex.; International Metallographic Society, Inc. (1970).

See CONF-690920.

Five different ($U_{0.8}$, $Pu_{0.2}$)C fuel types were fabricated and characterized for thermal and fast flux irradiation studies as part of the LMFBR program. The end product of the fabrication process was sintered pellets, approximately 0.250-inch in length and diameter, having densities in the range 88 to 94% theoretical. Three of the above fuel types had unmodified compositions, namely, hypostoichiometric, stoichiometric, and hyperstoichiometric, while the remaining two were modified with either Fe or $Cr_{23}C_6$. The purpose of modification was to eliminate any free (U,Pu) metal from the structure. The only composition that was ideally single phase was stoichiometric, and in the case of the two modified fuels, there were two secondary phases present. Thus, detailed metallography was required with these materials for phase identification, volume, and distribution, as well as the porosity attributes of size, distribution, and type. These were used in conjunction with other characterization data to determine whether the material was within specification for irradiation testing. Details will be presented relating the metallographic data to fabrication variables and other characterization information that was obtained from the areas of analytical chemistry and electron microprobe examination. (auth)

25802 PHASE DIAGRAM AND THERMODYNAMICS OF THE SYSTEM U–Ru–C. Holleck, H.; Kleykamp, H. (Kernforschungszentrum, Karlsruhe, Ger.). J. Nucl. Mater.; 35: 158-66(May 1970). (In German).

The uranium-ruthenium-carbon phase diagram was established at 1300°C using arc-melted and sintered samples of different compositions. The system had two ternary solid phases, the complex carbide U_2RuC_2 and URu_3C_x with a maximum carbon solubility of $x \approx 0.7$. U_2RuC_2 was formed peritectically and crystallized in a tetragonal structure with a = 3.445 to 3.455 Å and c = 12.563 to 12.592 Å. The Gibbs free energies of formation of URu_3 and URu_3C_x were determined with galvanic cells using a solid CaF_2 electrolyte. It is found that ${}^{f}\Delta G^0_T \langle URu_3\rangle = -53{,}800 + 8.4\ T$ [cal/mole], 1000 to 1140°K, ${}^{f}\Delta G^0_T \langle URu_3C_x\rangle = 53{,}100 - 7.0\ T$ [cal/mole], 860 to 1070°K. The standard entropy of URu_3 and the Gibbs free energy of formation of U_2RuC_2 were estimated. The high stability of the investigated phase URu_3C_x confirmed the elsewhere observed reaction $UC + 3\ Ru = URu_3C_x + (1 - x)C$. (auth)

Radiation Effects

Refer also to abstracts 25777 and 26777.

25803 (AI-AEC–12928) RESEARCH ON CARBIDE FUELS: AN IRRADIATION TEST OF SWELLING CONTROL BY FINE PARTICLE DISPERSIONS. Ervin, G. Jr. (Atomics International, Canoga Park, Calif.). 15 Mar 1970. Contract AT(04-3)-701. 61p. Dep. CFSTI.

An irradiation experiment on the swelling of uranium carbide fuel was performed to evaluate the concept of using a dispersion of fine particles in the fuel structure as a means of trapping fission gases as very small bubbles and thereby reduce swelling. The dispersions were made by additions of 1.5 to 3.0 wt % tungsten to the uranium monocarbide, and the specimens were irradiated to a maximum of ~2 at. % burnup. Density changes were used as the measure of swelling, comparing tungsten-doped specimens with undoped uranium monocarbide control specimens. There was a great deal of scatter in the results. Tungsten did cause a reduction in swelling for those groups in which a uniform dispersion was present. For some other groups having excess uranium and tungsten or a segregated structure (due to preparation by arc casting), tungsten caused an increase in swelling. It was concluded that the results provide tentative confirmation that fine particles are of value in reducing fission gas swelling of carbide fuels. (auth)

25804 (UNC–5253) FAST REACTOR MIXED-CARBIDE FUEL ELEMENT DEVELOPMENT PROGRAM. Tenth Quarterly Progress Report, October–December 1969. (United Nuclear Corp., Elmsford, N. Y. Research and Engineering Center) 16 Mar 1970. Contract AT(30-1)-3415. 30p. Dep. CFSTI.

The destructive post-irradiation examination of three fuel rods containing helium-bonded, high-density (UPu)C + 10 vol % $(UPu)_2C_3$ pellets irradiated to 40,000 MWd/t at 31 kW/ft in the EBR-II has been initiated. Results indicate what may be a reaction zone in the Type 316 stainless steel clad adjacent to the fuel. The fuel exhibited a structure similar to unirradiated material and that which has been observed in previous irradiation experiments. Three fuel rods, operating at 20 kW/ft in the EBR-II, have accumulated a peak burnup of 69,000 MWd/t. The rods contain helium-bonded, high-density uranium-plutonium carbide pellets. A fourth experiment containing sodium-bonded mixed-carbide pellet fuel rods was discharged from the GETR after achieving its goal burnup of 50,000 MWd/t. (auth)

25805 CORROSION OF LONG BERYLLIUM OXIDE TUBES IN GASEOUS, MOISTURE-LADEN STREAMS. Belyaev, R. A.; Danilov, Yu. I.; Furaev, S. A. At. Energ. (USSR); 27: 558-60 (Dec 1969). (In Russian).

BeO tubes were prepared by sintering at 2000 to 2100°K. Type A tubes had a density of 2.90 to 2.92 g/cm³, and type B tubes had a density of 2.50 to 2.84 g/cm³. It was found that the corrosion rate varied as a function of temperature, and also as a function of l/d. Hence it is necessary to take into effect saturation of the gaseous medium. Results obtained under one set of established conditions cannot be extended to other conditions if the effect of saturation (or l/d) is not taken into account. The results can be extended to other materials. (TTT)

25806 INTERACTION OF LASER AND ELECTRON BEAMS WITH DIAMOND SURFACES. Murphy, R.; Ritter, G. J. (National Physical Research Lab., Pretoria). Ind. Diamond Rev.; 174-80(May 1970).

Direct observations of the etch features induced on the surface of electron irradiated diamond have been made. It is shown that the etch features formed on the surface depend not only on the temperature but also on the ambient gas mixture about the irradiated diamond. A description of the etch features to be found on the surface of natural diamonds etched with a laser beam is also given. Observations suggest that some of the etch features are similar to those induced with an electron beam. (auth) (UK)

Plastics and Other Materials

Refer also to abstract 25681.

25807 (RISO–211) SOME TECHNOLOGICAL PROPERTIES OF WOOD–PLASTIC MATERIALS. Singer, K.; Vinther, A. (Danish Atomic Energy Commission, Risoe. Research Establishment); Thomassen, Th. (Technological Inst., Copenhagen (Denmark). Wood Dept.). Dec 1969. 30p. Dep. CFSTI (U. S. Sales Only).

English version of Riso-M–759, June 1968.

Properties of wood-plastic materials are described. The materials consist of combinations of beech and pine with poly(methyl methacrylate), poly(vinyl acetate), and poly(styrene/acrylonitrile). The properties investigated comprise machining and gluing properties, bending strength, hardness, water absorption, and dimensional stability as well as density and distribution of polymer in large wood samples. It is concluded that impregnation with poly(methyl methacrylate) leads to improved bending strength, hardness and dimensional stability, but poorer machining and gluing properties; poly(styrene/acrylonitrile) increases the hardness, substantially improves the dimensional stability and gives no great difficulties in machining and gluing; poly(vinyl acetate) seems to give no improvements of any appreciable interest. (auth) (Denmark)

25808 (UCRL–50799) RADIATION-ENHANCED DIFFUSION IN SILICON: A REVIEW AND ANALYSIS. Ferderber, Lawrence J. (California Univ., Livermore. Lawrence Radiation Lab.). 3 Mar 1970. 15p. Dep. CFSTI.

The effects of radiation enhancement on defect concentration were studied in attempts to learn more about the diffusion process in Si. A brief mathematical description is given of the diffusion mechanism, as presently understood in which the role of lattice defects is established as a principal phenomenon in diffusion. The known and proposed defects are described. A survey of reported radiation-enhanced diffusion data is provided. Selected data are analyzed, and conclusions are reached as to the validity and significance of the reported data. The experimental results are compared with the existing theoretical predictions. Although no conclusive results are obtained, it is shown that vacancy-impurity complexes (in particular, the vacancy-oxygen complex) are probably the dominant defect associated with impurity diffusion in silicon. (auth)

25809 (UCRL–72092) POISSON'S RATIO FOR RIGID PLASTIC FOAMS. Rinde, J. A. (California Univ., Livermore. Lawrence Radiation Lab.). 19 Nov 1969. 23p. (CONF-700511–1). Dep. CFSTI.

From SPE 28th Annual Technical Conference, New York.

Poisson's ratio for several low-density plastic foams has been determined in both tension and compression. For polystyrene bead foams and a polyurethane foam, Poisson's ratio is greater in tension than compression. In compression, Poisson's ratio is not linear, showing a larger value below the yield strain and a value near zero for high strains. For 0.05 and 0.10 g/cc polystyrene bead foam, Poisson's ratios are $1/3$ in tension and $1/4$ in compression below the yield strain; at higher strains the value in compression is in the range 0.03 to 0.07. (auth)

25810 INFLUENCE OF γ-RAYS ON THE PROPERTIES OF SOME LUBRICANTS. Schulze, D. K. W.; Reith, H. Schmierstoffe Schmierungstech.; No. 31, 52-62(1968). (In German).

Experiments were performed to determine the effects of γ radiation on the lubricating properties of mineral and synthetic lubricating oils under various operating conditions. The results showed that mineral oils can be used if the radiation dose between lubrications does not exceed 10^7 kR. At around 10^8 kR, the oil should be tested under operating conditions before being used. If the doses between lubrications exceed 10^8 kR, radioresistant synthetic lubricants, like polyphenylether or polyphenylthioether, must be used. At the Rossendorf Nuclear Research Center, polyphenylether was successfully used at γ-doses of 10^9 kR. Radioresistant synthetic lubricants, although more expensive, should be employed to protect valuable machinery even from lower doses of γ-radiation. (H.B.G.)

25811 SYNTHETIC ADDITIVE MATERIALS FOR CONCRETES OR BUILDING ELEMENTS FOR PROTECTION AGAINST IONIZING RADIATIONS. Koch, Anton. British Patent 1,185,893. 25 Mar 1970. Priority date 29 Jul 1966, Germany.

Concrete with a composition consisting of cement and a particulate artificial aggregate of cement bonded inorganic granular material with a portion of the inorganic granular material having a specific gravity of 4 was developed. The artificial aggregate contains fine grained inorganic materials which have large capture cross-sections for thermal neutrons. The concrete composition is then heat treated with superheated steam at a pressure of 8 to 15 atmospheres. (J.C.W.)

25812 THE EFFECT OF IONIZING RADIATION ON THE THERMAL PROPERTIES OF LINEAR HIGH POLYMERS. PART I. VINYL POLYMERS. Gee, D. R.; Melia, T. P. (Univ. of Salford, Eng.). Polymer; 11: 178-91(Apr 1970).

A differential scanning calorimeter has been used to measure the heat capacities (over the temperature range 200 to 500°K) of polyethylene single crystals and melt crystallized samples of polyethylene and isotactic polypropylene, which had been subjected to different doses (0 to 1000 Mrads) of cobalt-60 gamma radiation at 298°K and 425°K, respectively. Melting temperatures, heats and entropies of fusion of the irradiated samples are listed. Changes in these parameters with radiation dose are interpreted in terms of ordering processes in the liquid and solid phases, which result from the radiation induced formation of intermolecular crosslinks. (auth) (UK)

25813 THE EFFECT OF IONIZING RADIATION ON THE THERMAL PROPERTIES OF LINEAR HIGH POLYMERS. PART 2. NYLON-6. Gee, D. R.; Melia, T. P. (Univ. of Salford, Eng.). Polymer; 11: 192-7(Apr 1970).

A differential scanning calorimeter has been used to measure the heat capacities of nylon-6 samples, which had been subjected to different doses (0—1000 Mrads) of cobalt-60 gamma radiation at 298°K, over the temperature range 200 to 550°K. At doses up to 200 Mrads the melting temperature decreases steadily with dose while the heat and entropy of fusion steadily increase. Above this dose a second peak appears in the heat capacity versus temperature plot. With increasing dose this low temperature peak becomes more apparent while the melting transition becomes less so. Possible explanations of these effects are proposed. (auth) (UK)

25814 THERMOLUMINESCENCE IN POLYETHYLENE. I. ELECTRON TRAPS. Boustead, I.; Charlesby, A. (Royal Military Coll. of Science, Shrivenham, Eng.). Proc. Roy. Soc. (London), Ser. A; 316: 291-302(Apr 1970).

For a slow warming rate, the thermoluminescence glow curves of a wide range of polyethylene samples have been recorded. All show five similar glow peaks. One of these is confirmed as electron trapping on molecular oxygen. It is shown that the remaining four peaks are a property of the polymer itself; of these, two are associated with main chain unsaturation and two with cavities or similar defects in the folded and amorphous regions of the solid. The role of phosphorescence quenching in the recording of thermoluminescence glow curves is briefly discussed. (auth) (UK)

25815 THE EFFECTS OF EXPOSURE TO ELEVATED TEMPERATURES ON TIME-DEPENDENT STRAINS IN CONCRETE. Birkimer, D. L.; Lankard, D. R.; Fondriest, F. F.; Snyder, M. J. (Battelle Memorial Inst., Columbus, Ohio). pp 1349-57 of Pressure Vessel Technology. Pt. II. New York; American Society of Mechanical Engineers (1969).

From 1st International Conference on Pressure Vessel Technology, Delft, Netherlands. See CONF-690906(Pt.2).

The results of measurements of the cumulative deformation exhibited by concrete when subjected to various conditions of stress and heating at temperatures up to 500°F. It is shown that the sign and magnitude of the time-dependent deformations exhibited by the heated concrete are dependent on the period in the concrete's heating history in which the load is applied. The various sources of deformation, which collectively account for the gross deformation in heated and loaded concrete as a function of time, do not operate independently of one another in terms of their individual contributions to the gross deformation. (auth)

PHYSICS (GENERAL)

Astrophysics and Cosmology

25816 (NEIC-RR-34) NUCLEAR AND RELATIVISTIC ASTROPHYSICS AND NUCLIDIC COSMOCHEMISTRY, 1963–1967. VOLUME 1. Kuchowicz, B. (Nuclear Energy Information Center, Warsaw (Poland)). 1968. 372p. Dep. CFSTI (U. S. Sales Only).

This three volume set of reports covers the literature on nuclear and relativistic astrophysics for the years 1963-1967. The first volume is the literature survey and the other two volumes include the bibliography (5690 references). The material is grouped according to the headings: major bodies of the solar system; meteorites, tektites, and cosmic dust; the stars; abundances in the galaxies and interstellar medium; nuclidic abundances in the solar system and stars; space research (general topics); solar cosmic rays; primary corpuscular cosmic radiation; x-ray and gamma-ray astronomy; nuclear energy generation and nucleosynthesis in stars; general problems in stellar structure; cosmogony of stars and planetary systems; stellar models and evolution; stellar pulsations; novae and supernovae; neutrino astrophysics; laboratory research in astrophysics; galaxies; strong radio sources and quasars; gravitational collapse; superdense matter; other applications of general relativity to astrophysics; cosmology; antimatter; elementary particles in cosmology; and the search for strange types of elementary particles. (W.D.M.)

25817 (NEIC-RR-37) NUCLEAR AND RELATIVISTIC ASTROPHYSICS AND NUCLIDIC COSMOCHEMISTRY: 1963–1967. VOLUME II. Kuchowicz, B. (Warsaw Univ. (Poland)). 1969. 304p. Dep. CFSTI (U. S. Sales Only).

25818 (NEIC-RR-38) NUCLEAR AND RELATIVISTIC ASTROPHYSICS AND NUCLIDIC COSMOCHEMISTRY: 1963–1967. VOLUME III. Kuchowicz, B. (Warsaw Univ. (Poland)). 1969. 265p. Dep. CFSTI (U. S. Sales Only).

25819 HIGH-ENERGY ASTROPHYSICS. Weekes, Trevor C. New York; Barnes and Noble, Inc. (1969). 217p. $9.50.

An introduction is given for the reader with no background in astronomy this is followed by an account of violent stellar phenomena, novae and supernovae, and their more spectacular counterparts, the radio galaxies and quasars. The problems that arise in explaining the energy output from these objects are emphasized. The persistent problem of the origin of the cosmic radiation is reviewed in the light of recent research. An account is given of the methods and results of the new astronomies: x-ray, γ-ray, and neutrino. The discovery of the 3°K blackbody field is described and the implications for cosmology and astrophysics are discussed. Although the presentation is generally qualitative, the topics of synchrotron radiation and inverse Compton scattering are discussed in some detail. Pulsars are covered in a chapter added in proof. (W.D.M.)

25820 EXTRA-ATMOSPHERIC SUBMILLIMETER-WAVE ASTRONOMY. Salomonovich, A. E. Usp. Fiz. Nauk; 99: 417-38(Nov 1969). (In Russian).

The problems and methods of submillimeter astronomy are discussed. A review is given of studies of the chemical and isotopic composition of the intergalactic and interstellar media, infrared stars and quasars, solar radiation, and planets. (R.V.J.)

25821 FREE RADICALS IN ASTROPHYSICS. Swings, P. (Institut d'Astrophysique, Liege). Mem. Soc. Roy. Sci. Liege; 18: 1-26(1969).

This review covers mainly results obtained in the last twelve years. Some recent results on the role of the OH radical in interstellar physics are covered in some detail. Typical diatomic or triatomic radicals considered include CN, CH, C_2, NH, OH, TiO, AlO, ZrO, VO, CaO, YO, AlH, C_3, NH_2, and SiC_2. (W.D.M.)

Cosmic Ray Exposure Ages

25822 (UCB-34-P-32-PR-4) MASS SPECTROSCOPY RESEARCH. Progress Report. (California Univ., Berkeley. Dept. of Physics). Sep 1969. 15p. Dep. CFSTI.

A list of papers published and papers in process is given and short discussions are given for each paper. Work in progress is briefly discussed in terms of ^{39}Ar–^{40}Ar dating of meteorites, xenon in whitlockite from St. Severin, composition of fission Xe from laboratory samples of transuranic nuclides (including ^{244}Pu), and preparations for analyses of lunar samples. Work planned for 1970 is mentioned. (W.D.M.)

Stars

25823 PHOTOELECTRIC OBSERVATIONS OF LUNAR OCCULTATIONS. de Vegt, Chr.; Pansch, E. (Hamburger Sternwarte, Hamburg). Astron. Astrophys.; 5: 328-9(Apr 1970).

A table of lunar occultations of 18 stars from April to Dec. 1969 is given. The Fresnel diffraction pattern of each occultation event was analyzed with a resolution of 1 ms. (W.D.M.)

25824 THE BLANKETING EFFECT IN Am STARS. Ferrer, O.; Jaschek, M.; Jaschek, C. (Observatorio Astronomico, La Plata). Astron. Astrophys.; 5: 318-21(Apr 1970).

It is shown that blanketing corrections for Am stars can be deduced from UBVRI photometry alone and that the metallicity, defined spectroscopically, is related to the modulus of the blanketing vector, defined photometrically. (auth)

25825 PHOTOELECTRIC UBV PHOTOMETRY OF THE OPEN CLUSTER NGC 2516. Dachs, J. (Ruhr-Univ., Bochum, Ger.). Astron. Astrophys.; 5: 312-17(Apr 1970).

Seventy stars in the region of the open cluster NGC 2516 were investigated by photoelectric UBV photometry down to magnitude V = 12m with a 24-inch Cassegrain telescope at the European Southern Observatory, La Silla (Chile). An interstellar reddening of $E_{(B-V)}$ = 0.09m and a photometric distance of 375 ± 20 pc were derived from the discussion of magnitudes and colors. The cluster contains three red giants of luminosity classes II–III. Among the cluster stars with peculiar spectra (Bp and Ap), the Si II and Hg II stars show a tendency to be bluer than nonpeculiar stars of equal magnitude by about $\Delta(B - V) = -0.03$m in the color–magnitude diagram. The cluster has very nearly the same age as the Pleiades, but contains more than twice the number of stars of visual absolute magnitude ranging from −3m to +3m compared with the Pleiades. (auth)

25826 PHOTOMETRIC ELEMENTS OF THE FT ORIONIS BINARY SYSTEM. Cristaldi, S. (Osservatorio Astrofisico, Catania, Italy). Astron. Astrophys.; 5: 228-31(Apr 1970).

The light curve and the photometric elements of FT Orionis are given. The observations show that the secondary minimum falls at phase φ = 0.746 d and that the eccentricity is e = 0.400. The two components of the system have nearly the same radius. The spectral type of the secondary component, obtained from the photometric data, is A3. (auth)

25827 NONLINEAR LIMITING OF THE GOLDREICH–SCHUBERT INSTABILITY. James, R. A.; Kahn, F. D. (Univ. of Manchester, Eng.). Astron. Astrophys.; 5: 232-9(Apr 1970).

The development of one of the unstable modes of the Goldreich–Schubert instability leads to changes in the angular momentum distribution in a star. After a certain stage, the mode is limited by a rapid instability involving motions along isentropic surfaces. All unstable modes are limited by this effect, and it seems unlikely that the angular momentum distribution setup can be destroyed. The time scale for redistribution of angular momentum in stars is probably much longer than the Kelvin–Helmholtz time. (auth)

25828 A STUDY OF THE SOUTHERN OPEN CLUSTERS: Tr 27, Tr 28, NGC 6416, AND NGC 6425. The, P. S.; Stokes, N. (Astronomical Inst., Amsterdam). Astron. Astrophys.; 5: 298-311 (Apr 1970).

A photometric study on the UBV system of the southern open clusters Tr 27, Tr 28, NGC 6416, and NGC 6425, based on a photoelectric sequence in the open cluster NGC 6405, was undertaken photographically using plates taken with the Uppsala and Lembang Schmidt telescopes. For zeropoint corrections of the photographic photometry at least 7 stars in each cluster were measured photoelectrically using the 40″ and 16″ telescopes at Siding Spring Station of Mt. Stromlo Observatory. Fundamental data of the open clusters are obtained, using Becker's method. They indicate that Tr 27 and Tr 28 are located at the Sagittarius spiral arm as delineated by optical spiral tracers, while NGC 6416 and NGC 6425 are interarm objects. The cluster membership of several interesting stars located in the cluster area is discussed. (auth)

25829 THE PLANETARY NEBULAE. XII. Aller, Lawrence H. (Univ. of California, Los Angeles). Sky Telesc.; 39: 299-303(May 1970).

Spectra of central stars of planetary nebulae are illustrated and the five star classes observed thus far are briefly discussed. Other topics considered include central stars and spiral-arm stars, stellar winds in planetaries, binary central stars, and Wolf-Rayet central stars. (W.D.M.)

25830 EVOLUTION OF STARS OF TWELVE SOLAR MASSES. Ferrari d'Occhieppo, K.; Firneis, F.; Tscharnuter, W. Oesterr. Akad. Wiss., Math.-Naturwiss. Kl.; 177: 443-61(1968). (In German).

The evolution of a 12 M⊙ star was studied, using the computer program of Hofmeister, Kippenhahn, and Weigert. The calculations started with a chemically homogeneous model of 4.4% heavy elements, 60% hydrogen, and 35.6% helium. The general lines of evolution were found to be similar to, but much more rapid than for the most massive star hitherto investigated by the Kippenhahn and Weigert group. In the final stages the procedure became inefficient even with very short time steps. The results are given in tables and diagrams. (auth)

25831 SUPERMASSIVE STARS AND NEUTRINO EMISSION. Bandyopadhyay, P.; Chaudhuri, P. Ray (Indian Statistical Inst., Calcutta). Lett. Nuovo Cim.; 3: 269-71(26 Feb 1970).

Bandyopadhyay (Phys. Rev., 173: 1481(1968)) suggested that photons can interact weakly with neutrinos and estimated the rate of energy loss due to the interaction $e^+ + e^- \rightarrow \nu + \bar{\nu}$. The role of neutrino emission from supermassive stars is studied, taking into account this photon–neutrino weak-coupling theory. (W.D.M.)

25832 VARIABILITY OF THE POLARIZATION OF Z VUL. Shoulov, O. S.; Houdkova, G. A. Uch. Zap. Leningrad. Gos. Univ., Ser. Mat. Nauk; No. 347, No. 44, 37-47(1969). (In Russian).

About 200 polarimetric observations of the eclipsing binary Z Vul were made photoelectrically in 1964–1967 and the small variations with phase were detected in the polarization parameters. The observed polarization is the vector sum of the interstellar component and the intrinsic one, the latter being variable. The photometric, polarimetric, and spectral observations of 23 stars in the neighborhood of Z Vul were carried out to find the unknown interstellar component and to derive the intrinsic polarization. The intrinsic polarization derived in such a way can be satisfactorily interpreted as caused by radiation scattering by the free electrons of the gaseous ring surrounding the brighter star of the system. The curve of the intrinsic polarization was used to estimate the mass of the ring $m = 9.5 \times 10^{22}$ g $= 4.8 \times 10^{-11}$ M⊙. This estimate is derived under the assumption that the ring is of pure hydrogen, which is completely ionized. (auth)

25833 DYNAMICS OF THE GASEOUS JET IN CLOSE BINARY SYSTEMS OF DWARF STARS. I. Taranov, V. I. Uch. Zap. Leningrad. Gos. Univ., Ser. Mat. Nauk; No. 347, No. 44, 25-32 (1969). (In Russian).

The shock-wave in the gaseous stream is formed when it flows into the envelope of the primary star of the close binary system. The temperature and density in the shock are determined, the energy losses with the radiation and the influence of the magnetic field being taken into account. The position of the shock front is also found. (auth)

25834 DISTRIBUTION OF THE ELECTRON TEMPERATURE IN THE ENVELOPES OF THE CLOSE BINARY STARS. Ivanov, L. N. Uch. Zab. Leningrad. Gos. Univ., Ser. Mat. Nauk; No. 347, No. 44, 33-6(1969). (In Russian).

The electron temperature of the disc-like envelope of the star R W Tri is estimated using the U, B, V light curves during the eclipse. It is found that the temperature of the outer layers of the envelope is the order of 3×10^4 °K. The values of T_e are smaller in the internal layers of the envelope. (auth)

25835 EVOLUTION OF ROTATING WHITE DWARFS. Schwartz, Robert; Africk, Steven (Brown Univ., Providence). Astrophys. Lett.; 5: 141-4(Apr 1970).

The formation of a lattice by the ions in the interior of a differentially rotating white dwarf is important in changing the distribution of angular momentum. This effect can lead to the formation of an unstable, rigidly rotating core, in a time which may be less than 10^6 years. The lifetime of a differentially rotating white dwarf varies approximately as Z^{-6}, where Z is the charge on the ions in the interior. (auth)

25836 LITHIUM CONTENT IN LATE-TYPE GIANTS. Boesgaard, Ann Merchant (Univ. of Hawaii, Honolulu). Astrophys. Lett.; 5: 145-8(Apr 1970).

It is shown that Warner's recent re-analysis of Bonsack's Li abundances in G and K stars leads to a consistent picture of the Li content in all late-type giant stars. The Li content decreases monotonically with temperature from F5 to M4, with no pronounced dip for the late K stars as found earlier. (auth)

25837 RECOMBINATION LINES IN NGC 7027. Goldberg, Leo (Harvard Coll. Observatory, Cambridge, Mass.). Astrophys. Lett.; 5: 151-2(Apr 1970).

The absence of the hydrogen 109α recombination line in the planetary nebula NGC 7027 (Terzian and Balick 1969) suggests that the populations of the levels n = 109 and 110 are very close or equal to their LTE values and that the nebula is optically thick in continuum radiation at $\nu = 5$ GHz. The near-LTE populations imply a lower limit to the electron density of 10^6 cm^{-3}. If the suggested explanation for the absence of the 109α line is correct, recombination lines should be observed at frequencies of 10 to 12 GHz or greater. (auth)

25838 DETECTION OF THE H65α RADIO RECOMBINATION LINE IN ORION A. Churchwell, E.; Mezger, P.; Reifenstein III, E.; Rubin, R.; Turner, B. (National Radio Astronomy Observatory, Green Bank, W. Va.). Astrophys. Lett.; 5: 157-60(Apr 1970).

Observations of the H65α-recombination line at 23.404 GHz in the center of Orion A are reported. The observed set of parameters is consistent with α-line parameters observed at other frequencies. The LTE-electron temperature is 7200^{+2300}_{-2000} °K. The implications of the H65α line results on the non-LTE theory of radio recombination lines are discussed. (auth)

25839 SPHERICAL AND CYLINDRICAL NONLINEAR WAVES. Gintsburg, M. A. Sov. Astron. AJ (Engl. Transl.); 13: 799-806 (Mar-Apr 1970).

Translated from Astron. Zh.; 46: 1019-28(Sep-Oct 1969).

The nonlinear evolution of spherical, cylindrical, and plane plasma clouds is investigated. If the expanding plasma is strongly inhomogeneous ($n \sim 1/r^2$), the Debye radius no longer represents the characteristic length, and self-similar flow prevails. The following problems are solved numerically and by expansion in series: (1) the evolution of a nonisothermal soliton (plasmoid) with stationary electrons having the distribution $n \sim e^{\varphi}$ ($T_e \gg T_i$); (2) the evolution of a soliton with nonstationary electron pressure $p = n\varkappa T_e$ and $T_i = 0$; (3) the evolution of a soliton with cold electrons ($T_e = T_i = 0$); (4-6) stationary ($\partial/\partial t \equiv 0$) two-dimensional flows corresponding to problems (1-3). The nonstationary problems are solved for all three geometries; the stationary problems, for the cylindrical and plane cases. The expansion of a cold magnetized plasma is also considered (plasma cylinder and plane layer), for both nonstationary one-dimensional and stationary two-dimensional flows. The principal new effects discovered are: (1) pulses in the density and velocity will develop in expanding plasma; (2) the velocity and electric field will experience changes in sign and oscillations; (3) particles will be accelerated most strongly in the region through which the soliton has already passed. This ion-acceleration effect may be important in active regions on the Sun as well as in cometary atmospheres (a spherical nonlinear wave in the presence of an absorbing center). (auth)

25840 GRAVITATIONAL STABILITY OF A GAS SPHERE. Shnol, E. E. (Inst. of Applied Mathematics, Moscow). Sov. Astron. AJ (Engl. Transl.); 13: 762-8(Mar-Apr 1970).

Translated from Astron. Zh.; 46: 970-7(Sep-Oct 1969).

The classical problem of the equilibrium stability of a gas sphere in its own gravitational field is discussed. It is shown that the following conditions are necessary and sufficient for stability against arbitrary perturbations: (a) stability against radial perturbations; (b) absence of convection. (auth)

25841 MODEL ATMOSPHERES FOR CENTRAL STARS OF PLANETARY NEBULAE. Hummer, D. G.; Mihalas, D. (Univ. of Colorado, Boulder. National Bureau of Standards, Boulder, Colo.). Mon. Notic. Roy. Astron. Soc.; 14: 339-54(1970).

Approximately 70 model atmospheres for the central stars of planetary nebulae have been computed under the assumptions of hydrostatic, radiative and local thermodynamic equilibrium, and of plane–parallel stratification. These models have effective temperatures and surface gravities in the range $30{,}000°\text{K} \le T_{\text{eff}} \le 200{,}000°\text{K}$ and $3.4 \le \log g \le 7.5$. The atmospheres have been taken to consist of hydrogen, helium, oxygen, nitrogen, carbon, and neon, and the opacity included contributions from both ground and excited states of each ion. The transfer equation is solved using Feautrier's (1964) method and the temperature corrections are calculated by means of the Krook–Avrett (1963) procedure. Particular attention is given to the effects of gravity and chemical composition on the surface fluxes. The photon fluxes in the H I, He I, and He II continua and the stellar flux at Hβ have been tabulated for use in the determination of Zanstra temperatures. (auth) (UK)

25842 ORBITAL ELEMENTS OF SIX SPECTROSCOPIC BINARY STARS. Bopp, Bernard W.; Evans, David S.; Laing, J. D. (Univ. of Texas, Austin). Mon. Notic. Roy. Astron. Soc.; 147: 355-66(1970).

Orbital elements of the spectroscopic binary stars, HD 1273, 148704, 167954, 194215, 202940, and 217792 are presented.

HD 148704 shows double lines on a few plates and a somewhat uncertain mass ratio is determined. For HD 217792 elements have been previously published by Buscombe and Morris (1961). The present solution uses a period almost exactly half theirs. The method described in the Appendix has been used to investigate thoroughly large ranges of trial periods and to eliminate some alternative cases, including, in the case cited, the period adopted by Buscombe and Morris. (auth) (UK)

25843 EXPANDING ATMOSPHERES IN OB SUPERGIANTS. V. ULTRAVIOLET RESONANCE LINES AND RADIATIVE ACCELERATION IN ORION SUPERGIANTS. Hutchings, J. B. (Dominion Astrophysical Observatory, Victoria, B. C.). Mon. Notic. Roy. Astron. Soc.; 147: 367-76(1970).

Line profiles are computed for the observed ultraviolet resonance lines in the Orion supergiants. Initial velocity and ion density distributions are deduced that lead to approximate numerical estimates of radiative acceleration processes affecting the entire atmospheric mass. Recomputation of the line profiles yields a very close fit with observation. A mass loss rate of 10^{-6} $M_\odot$ yr^{-1} is deduced for these stars. Some general remarks are made on mass loss from early-type supergiants. (auth) (UK)

25844 SOME GENERAL RELATIVISTIC INEQUALITIES FOR A STAR IN HYDROSTATIC EQUILIBRIUM. II. Islam, Jamal N. (Univ. of Cambridge, Eng.). Mon. Notic. Roy. Astron. Soc.; 147: 377-86(1970).

Two theorems are proved involving the variables that describe the interior of a star in hydrostatic equilibrium in general relativity. These theorems are analogues of two classical theorems. (auth) (UK)

25845 CONTINUOUS ABSORPTION COEFFICIENTS FOR NONHYDROGENIC ATOMS. Peach, G. (University Coll., London). Mem. Roy. Astron. Soc.; 73: 1-123(1970).

In two earlier papers, free–free and bound–free continuous absorption coefficients were calculated for the atoms and ions C, N, O, Mg, Mg^+, Si, Cl, and Ca^+ in the temperature range 4000 to 13,000°K. These tables have now been revised and extended to include He, Li, C^+, C^{+2}, N^+, N^{+2}, O^+, Na, Al, Al^+, Si^+, and K, and the range of temperature considered was increased to 48,000°K. (auth) (UK)

25846 METHOD FOR COMPUTING THE EVOLUTION OF STAR CLUSTERS. Larson, Richard B. (Yale Univ., New Haven). Mon. Notic. Roy. Astron. Soc.; 147: 323-37(1970).

A method is described for computing the evolution of a spherical stellar system, using a fluid-dynamical approach based on the numerical solution of moment equations derived from the Boltzmann equation. Moments of the velocity distribution up to the fourth order are included in this treatment. In order to represent relaxation effects, "collision terms" are included and are evaluated using the Fokker–Planck equation. The principal assumption of the method is that the velocity distribution deviates by only a small amount from a Maxwellian distribution; however, it has been attempted to allow for a large anisotropy of the velocity distribution in the outer part of the system. To illustrate the application of the method, it is applied to the problem of the "gravothermal catastrophe" of an isothermal sphere, as recently discussed by Lynden-Bell & Wood (1968). The results confirm the predictions of Lynden-Bell & Wood concerning the instability and thermal runaway of an enclosed isothermal sphere when the central condensation becomes too high; however, the time scale for the ensuing "gravothermal catastrophe" is found to be much longer than the relaxation time. A discussion of the results shows that the rate of evolution is intimately related to the overall structure of the system; the more closely it approaches an isothermal structure with a Maxwellian velocity distribution, the slower is the evolution. (auth) (UK)

25847 SOME OBSERVATIONS OF DOUBLE STARS WITH THE NARRABRI STELLAR INTERFEROMETER. Herbison-Evans, D.; Cramer, N. (Univ. of Sydney). Proc. Astron. Soc. Aust.; 1: 205(Mar 1969).

The Narrabri Stellar Interferometer was used to observe the binary stars α Vir (April 1966) and γ_2 Velorum (Jan. 1968). (W.D.M.)

25848 HYDROGEN-ALPHA PROFILES IN CEPHEIDS. Schmidt, E. G. (Australian National Univ., Canberra). Proc. Astron. Soc. Aust.; 1: 205-6(Mar 1969).

Theoretical Hα profiles were used by Rodgers and Bell (Mon. Notic. Roy. Astron. Soc., 136: 91(1967)) to obtain the effective temperatures of several cepheid variable stars. They found that the profiles are sufficiently sensitive to temperature to enable them to determine temperatures which are accurate to within about 300°, while being insensitive to other factors such as gravity or the form of the temperature distribution in the model atmosphere. The calculation of Hα profiles has been redone incorporating several differences from those of Rodgers and Bell. A semi-empirical method of dealing with Stark broadening was used. (W.D.M.)

25849 PROPER MOTIONS IN THE FIELD OF THE OPEN CLUSTER NGC 6475 (M 7). Constantine, Susan M.; Harris, B. J.; Nikoloff, I. (Perth Observatory, Australia). Proc. Astron. Soc. Aust.; 1: 207-8(Mar 1969).

Four plate pairs, with epoch differences ranging from 49 to 75 years and an average of 58 years, were used to determine an absolute motion for the cluster of –0.0048" in R.A. and –0.0056" in declination. (W.D.M.)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstract 26103.

25850 (CSIRO-Trans–9489) OBSERVATIONS OF FAINT HII REGIONS IN ERIDANUS. Sheglov, P. V. Translated by A. K. Rothfield (Commonwealth Scientific and Industrial Research Organization, Melbourne, Australia), from Astron. Tsirk.; No. 412, 2-3(Mar 1967). 2p. Dep. CFSTI (U. S. Sales Only).

Geocoronal Hα emission observations of nightglow with a Fabry–Pérot etalon showed a long filament between α of 3h 30m and 4h. Maxima of Hα emission differ from those obtained by J. Meaburn, possibly due to observations being made in a narrow range of velocities. (Australia)

25851 (CSIRO-Trans–9509) SCINTILLATING RADIO SOURCES AT METRE WAVELENGTHS. Antonova, T. D.; Vitkevich, V. V.; Shabanova, T. V. Translated by A. D. Rothfield (Commonwealth Scientific and Industrial Research Organization, Melbourne, Australia), from Astron. Tsirk.; No. 447, 4-6(Oct 1967). 3p. Dep. CFSTI (U. S. Sales Only).

Scintillations of about 40 radio sources from catalogs 3C and 3CR were measured at 3.5 and 5 m with the radio telescope DCR–1000. (Australia)

25852 (CSIRO-Trans–9716) ON RAPID FLUCTUATIONS OF THE RADIO EMISSION OF THE QUASAR 3C-273. Lipovka, N. M. Translated by A. K. Rothfield (Commonwealth Scientific and Industrial Research Organization, Melbourne, Australia), from Astron. Tsirk.; No. 467, 1-3(Apr 1968). 4p. Dep. CFSTI (U. S. Sales Only).

Observations were made at 7700 MHz with the Pulkova radiotelescope at 3.75 cm. A steep increase in radio-flux density occurred in early November 1967. The results of observations are depicted from 1965 through 1968. (Australia)

25853 (CSIRO-Trans–9719) SCINTILLATIONS ON THE IRREGULARITIES OF NEBULAR PLASMA AS THE CAUSE OF VARIATION OF THE INTENSITY OF OH LINE EMISSION OF RADIO SOURCES. Vitkevich, V. V.; Malov, I. F. Translated by A. K. Rothfield (Commonwealth Scientific and Industrial Research Organization, Melbourne, Australia), from Astron. Tsirk.; No. 463, 1-3(Mar 1968). 3p. Dep. CFSTI (U. S. Sales Only).

Variations of the intensity of OH sources in NGC 6334 and W3 due to scintillations are considered in terms of basic parameters and are found not to contradict existing observations. (Australia)

25854 (CSIRO-Trans–9898) MEASUREMENT OF FLUX DENSITY OF A PULSAR AT 2.07 m WAVELENGTH. Popov, V. N.; Yurovskii, Yu. F. Translated by M. A. Hintze (Commonwealth Scientific and Industrial Research Organization, Melbourne, Australia), from Astron. Tsirk.; No. 476, 1-3(Aug 1968). 6p. Dep. CFSTI (U. S. Sales Only).

The flux density of the source at α_{1950} = 19h 19m 38s and δ_{1950} = 22°00 averaged for 5 m in the 2.5-Mc band on June 23, 1968 (0h 10m to 3h 00m UT) was $(35 \pm 10) \times 10^{-26}$ w/m² cps. The pulsating source intensity during one minute at 0h 00m UT reached 120×10^{-26} w/m² cps. (Australia)

25855 (CSIRO-Trans–9899) OBSERVATIONS OF PULSAR'S RADIO EMISSION AT 1m WAVELENGTH WITH THE AID OF DCR-1000. Alekseev, Yu. I.; Vitkevich, V. V.; Zhuravlev, V. F.; (and others). Translated by M. A. Hintze (Commonwealth Scientific and Industrial Research Organization, Melbourne, Australia), from Astron. Tsirk.; No. 476, 3-5(Aug 1968). 2p. Dep. CFSTI (U. S. Sales Only).

Regular observations at 93 Mc and random observations at 110, 106, and 73 Mc of CP 1919 showed variations in pulse amplitudes. Maximum recorded intensities of individual pulses came to 240, 200, and 80 units (corresponding to 110, 93, and 73 Mc). Apr.–May

1968 readings at 93 Mc pointed to 3- to 5-fold increase in power of pulsar emission in comparison with Aug.–Dec. 1967 (at 81 Mc). (Australia)

25856 (CSIRO-Trans-9909) PULSAR IN CRAB NEBULA AS A POSSIBLE SOURCE OF GRAVITATIONAL RADIATION. Shklovskii, I. S. Translated by M. A. Hintze (Commonwealth Scientific and Industrial Research Organization, Melbourne, Australia), from Astron. Tsirk.; No. 494, 4-6(Feb 1969). 4p. Dep. CFSTI (U. S. Sales Only).

The explanation of secular drag of the pulse of NP 0532 is postulated in terms of the comparatively low equatorial rotation speed. The change of shape to triaxial ellipsoid, on the brink of fragmentation, is also thought to be sufficient for the establishment of powerful gravitational radiation. (Australia)

25857 (CSIRO-Trans-9910) ON THE POSSIBLE CAUSE OF SECULAR INCREASE OF PULSAR PERIODS. Shklovskii, I. S. Translated by M. A. Hintze (Commonwealth Scientific and Industrial Research Organization, Melbourne, Australia), from Astron. Tsirk.; No. 494, 6-8(Feb 1969). 3p. Dep. CFSTI (U. S. Sales Only).

Assuming rotating pulsars are moving in the Galaxy at a very high speed, then due to the secular decrease of the radial component caused by the Doppler effect, there would always be an increase of rotation period, irrespective of the direction of pulsar movement. The galactic distribution of the pulsars now known is postulated as being a reason for their high speed. (Australia)

25858 (CSIRO-Trans-9912) SPECTRAL FLUX DENSITIES OF DISCRETE RADIO SOURCES AT 3.5 cm WAVELENGTH. Andrievskii, A. E.; Spangenberg, E. E.; Val'tz, I. E. Translated by M. A. Hintze (Commonwealth Scientific and Industrial Research Organization, Melbourne, Australia), from Astron. Tsirk.; No. 494, 1-3(Feb 1969). 2p. Dep. CFSTI (U. S. Sales Only).

Measurements of radio-emission flux from 130 sources are tabulated. These were taken during Aug.–Sept. 1968 using the RT-22 dish (Crimea–Suneis). (Australia)

25859 PECULIAR MOTIONS OF NEUTRAL HYDROGEN IN THE VICINITY OF THE ORION NEBULA. Menon, T. K. (Univ. of Hawaii, Honolulu). Astron. Astrophys.; 5: 240-3(Apr 1970).

A detailed study of the distribution of 21-cm emission in the vicinity of the Orion Nebula shows the presence of a neutral hydrogen cloud close to the Nebula which is approaching the Nebula with a velocity of about 14.2 km/s. It is suggested that the conical absorbing band seen in projection against the Nebula is part of the above cloud. The minimum density of neutral hydrogen atoms in the cloud is about 100 cm^{-3}. (auth)

25860 MAGNITUDES, COLORS, AND COORDINATES OF 175 ULTRAVIOLET EXCESS OBJECTS IN THE FIELD 13h, +36°. Braccesi, A.; Formiggini, L.; Gandolfi, E. (Laboratorio Nazionale di Radioastronomia, Bologna). Astron. Astrophys.; 5: 264-79(Apr 1970).

The positions and magnitudes in a four-color (u,b,v,i) system of 175 ultraviolet-excess objects down to b = 19.5 in a 6° × 6° degree field centered at 13 h, +36° are reported. Most of these objects appear to be Q.S.O.'s (Braccesi and Formiggini, 1969). The paper is divided in two sections: the first gives an exhaustive description of the photometric system employed and how it has been calibrated against the classical U, B, V system. The second section describes the catalogue itself. (auth)

25861 SUBMILLIMETER RADIATION FROM THE ORION NEBULA. Park, W. M.; Vickers, D. G.; Clegg, P. E. (Queen Mary Coll., London). Astron. Astrophys.; 5: 325-7(Apr 1970).

The flux from the Orion Nebula at 900 μm was measured to be $(4.5 \pm 1.6) \times 10^{-22}$ W/m^2/Hz. This result is discussed in the context of previously reported results. (auth)

25862 LOW-ENERGY COSMIC X-RAY MEASUREMENTS. Baxter, A. J.; Wilson, B. G.; Green, D. W. (Univ. of Calgary, Alberta). Can. J. Phys.; 47: 2651-66(1 Dec 1969).

An experiment to investigate cosmic x rays in the energy range 0.25 to 12 keV is described. The data-recovery system and methods of spectral analysis are considered. Results are presented for the energy spectrum of the diffuse x-ray component and its distribution over the northern sky down to 1.6 keV with a limited extension at 0.27 keV. In the energy range 1.6 to 12 keV, the spectrum is represented by: $I = (12.1 \pm 1.1)E^{-1.49\pm0.06}$ photons (cm^2 s sr keV)$^{-1}$, although separate analyses indicate a flattening below 4.5 keV to give: I = (13.8± [illegible]) $E^{-1.56\pm0.12}$ photons (cm^2 s sr keV)$^{-1}$ for $4.5 < E < 12$ keV and I = (9.2± [illegible]) $E^{-1.28\pm0.11}$ photons (cm^2 s sr keV)$^{-1}$ for $1.2 < E < 4.5$ keV. At the lowest energies, the flux appears to increase more rapidly and exhibits some anisotropy in arrival directions related to the gross galactic structure. Spectral characteristics of the Crab Nebula and Cygnus X-2 were also determined. (auth) (Canada)

25863 MICROWAVE LINES OF INTERSTELLAR FORMALDEHYDE. Barrett, Alan H. Comments At. Mol. Phys.; 1: 155-8(Dec 1969–Jan 1970).

The original discovery of CH_2O in absorption in interstellar space is briefly reviewed and the excitation temperature is discussed. The possibility of determining the C^{12}/C^{13} isotopic ratio in the interstellar medium is mentioned. (W.D.M.)

25864 HIGH-ENERGY GAMMA RAY ASTRONOMY. Fazio, G. G. (Smithsonian Astrophysical Observatory, Cambridge, Mass. Harvard Coll. Observatory, Cambridge, Mass.). Nature (London); 225: 905-11(7 Mar 1970).

It is stated that gamma-ray astronomy above 10 MeV is difficult from the experimental point of view, but promising data are beginning to appear. A brief historical introduction is given, followed by a survey of data for the energy regions 10 MeV to 1 GeV and above 10^{11} eV. The status of theoretical calculations is discussed, and the nature of future progress is indicated. An account is included of gamma-ray detectors employed. 61 references. (UK)

25865 INTERSTELLAR OH MOLECULES. Terzian, Yervant; Scharlemann, Ernst (Cornell Univ., Ithaca, N. Y.). Earth Extraterr. Sci.; 1: 103-22(Apr 1970).

The molecular lines thus far observed in the radio spectrum, along with other pertinent transitions, are listed. The present article summarizes research on the interstellar OH molecules in terms of OH observations, classification of OH emission sources, emission from excited OH states, and theory of OH emission. (W.D.M.)

25866 ORIGIN OF ABSORPTION LINES IN THE SPECTRA OF QUASISTELLAR OBJECTS. Shklovskii, I. S. (Shternberg Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.); 13: 734-7(Mar–Apr 1970).

Translated from Astron. Zh.; 46: 935-9(Sep-Oct 1969).

A critical analysis of the origin of the absorption lines in quasar spectra indicates that, in all likelihood, they are formed comparatively close to the quasar nucleus rather than in intergalactic space. The occurrence of several absorption systems in the spectrum of the same quasar, with a redshift z_{abs} considerably smaller than z_{em}, is interpreted as representing an "expulsion" of magnetized gas clouds from the vicinity of the quasar nucleus because of relativistic-particle pressure. The acceleration of the expelled clouds is estimated, and it is shown that after a few thousand years the velocity of the clouds may reach the observed values as derived from $z_{em} - z_{abs}$ (some tens of thousands of km/sec). (auth)

25867 VARIABLE RADIATION IN A MAGNETODYNAMIC QUASAR MODEL. II. PREDICTION OF RAPID BRIGHTNESS VARIATIONS. Ozernoi, L. M.; Chertoprud, V. E. (Lebedev Inst. of Physics, Moscow). Sov. Astron. AJ (Engl. Transl.); 13: 738-46(Mar–Apr 1970).

Translated from Astron. Zh.; 46: 940-50(Sep-Oct 1969).

The model proposed previously (Paper I) for the variable optical radiation of a quasar contains a "slow" (cyclic) and a "rapid" (fluctuating) component. The theory of Paper I for the "slow" brightness variations, which are associated with the rotational character of the motion of the plasma in a magnetoid, is here extended by a more detailed treatment of the "rapid" optical variability. An attempt is made to classify the anticipated types of "rapid" variations, including flare processes. The properties to be expected for the autocorrelation function of the brightness variations are predicted. In particular, it is shown that certain properties of the "slow" brightness variations should be reflected in the statistical properties of the "rapid" variations. This circumstance enables the model of Paper I to be tested against new observational material. A method is suggested for ascertaining the relative contribution of turbulence and flare processes in the "rapid" brightness variations. (auth)

25868 OBSERVATIONS AT PULKOVO OF THE DISTRIBUTION OF POLARIZED AND UNPOLARIZED RADIATION OVER THE RADIO SOURCE W44 AT 3.95 AND 6.6 CM. Soboleva, N. S. (Central Astronomical Observatory, Pulkovo, USSR). Sov. Astron. AJ (Engl. Transl.); 13: 750-3(Mar–Apr 1970).

Translated from Astron. Zh.; 46: 955-9(Sep-Oct 1969).

Observations are reported of the distribution of polarized and unpolarized radio emission over the supernova remnant W44 ($l^{II} \sim 34°$, $b^{II} \sim -34'$) at wavelengths of 3.95 and 6.6 cm with fan beams measuring 1.5′ and 2.4′ respectively. The measurements reveal that only the eastern part of the source is polarized. The maximum percentage polarization at 3.95 cm is (12 ± 1.5)%; at 6.6 cm, (4 ± 1.5)%. The percentage polarization declines simultaneously over the entire polarized region. The product of the electron concentration and the longitudinal magnetic field in irregularities is determined, assuming that depolarization takes place either in the galactic plane or within the source. The rotation measure is 125 ± 80 rad/m^2. No point features having a flux density > (2 to 3) $\cdot 10^{-26}$ W $\cdot$ m^{-2} $\cdot$ Hz^{-1} are detected in the source. The spectral index differs by < 0.15 in the eastern and western parts of the source. (auth)

25869 DEPENDENCE OF THE COLLISIONAL-EXCITATION CROSS SECTION FOR THE HYDROGEN ATOM ON THE PRINCIPAL QUANTUM NUMBERS OF THE LOWER AND UPPER LEVELS. **Krinberg, I. A. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Sov. Astron. AJ (Engl. Transl.); 13: 780-3(Mar-Apr 1970).**

Translated from Astron. Zh.; 46: 993-7(Sep-Oct 1969).

In the Bethe–Born approximation, which holds if $U \gg 1$ ($U = E/E_{nn_1}$ is the ratio of the energy of the colliding electron to the excitation energy of the transition $n \rightarrow n_1$), an analytic expression is obtained for the collisional-excitation cross section $\sigma_{nn_1}{}^B(U)$ of the hydrogen atom in terms of the principal quantum numbers n and n_1 of the lower and upper levels and the reduced energy U. It is shown that for arbitrary energies U the excitation cross section may be represented in the form $\sigma_{nn_1}(U) = \varphi(U)\sigma_{nn_1}{}^B(U)$, where the function $\varphi(U)$ is independent of the quantum numbers to within 20 to 30%. The form of the function $\varphi(U)$ is established from experimental data for the cross section $\sigma_{12}(U)$, enabling a semiempirical relation to be obtained for the excitation cross section $\sigma_{nn_1}(U)$ of the hydrogen atom for arbitrary n and n_1. For $n = 1$ and $n_1 = 2$ this relation agrees with the available experimental evidence, while for $U \gg 1$ and arbitrary n and n_1 it agrees with numerical computations in the Born approximation. (auth)

25870 FOCUSING OF RADIATION BY A GRAVITATIONAL FIELD. **Byalko, A. V. (Landau Inst. of Theoretical Physics, Moscow). Sov. Astron. AJ (Engl. Transl.); 13: 784-7(Mar-Apr 1970).**

Translated from Astron. Zh.; 46: 998-1002(Sep-Oct 1969).

A discussion is given of the focusing effect of gravitating bodies due to the curvature in the trajectory of light rays passing near them. The intensity distribution is derived for radiation passing close to a spherically symmetric body in the geometric- and wave-optics approximations. The possibilities of observing the effect are examined. The conditions most favorable for detection would be the observation of a distant radio source through the galactic-center region. (auth)

25871 EXCITATION AND SPECTRUM OF PLASMA TURBULENCE IN OBJECTS WITH A HIGH RADIATION DENSITY. **Krivorutskii, E. N.; Tsytovich, V. N. (Lebedev Inst. of Physics, Moscow). Sov. Astron. AJ (Engl. Transl.); 13: 788-96(Mar-Apr 1970).**

Translated from Astron. Zh.; 46: 1003-15(Sep-Oct 1969).

A discussion is given of the effects arising from the excitation in plasma of various types of turbulence pulsations (Langmuir waves, whistlers, and Alfvén, ionosonic, and magnetosonic waves), in objects having a high electromagnetic-radiation density, such as quasars and supernova envelopes. The turbulence spectra are derived and some estimates are obtained for the power generated. (auth)

25872 NEGATIVE REABSORPTION OF SYNCHROTRON RADIATION. **Sazonov, V. N. (Lebedev Inst. of Physics, Moscow). Sov. Astron. AJ (Engl. Transl.); 13: 797-8(Mar-Apr 1970).**

Translated from Astron. Zh.; 46: 1016-18(Sep-Oct 1969).

Negative reabsorption (intensification) of synchrotron radiation is shown to be possible not only if relativistic electrons in a magnetic field are embedded in a nonrelativistic plasma, but also if the nonrelativistic plasma is entirely absent. In the latter case the relativistic electrons should have a much higher energy density than the magnetic field. (auth)

25873 SPECTRAL PECULIARITIES IN THE RADIO EMISSION OF W41. **Ariskin, V. I.; Berulis, I. I. (Lebedev Inst. of Physics, Moscow). Sov. Astron. AJ (Engl. Transl.); 13: 883-5(Mar-Apr 1970).**

Translated from Astron. Zh.; 46: 1126-8(Sep-Oct 1969).

The radio emission from W41 was measured at the Radio Astronomy Station of the Lebedev Physics Institute at λ = 21.1 cm, 2.6 m, 3.5 m, and 5 m. The results indicate that in the direction toward W41 there is a nonthermal radio source with a spectral index $\alpha = 1.43$ and an angular diameter of 18′, as well as a thermal source 34′ in diameter. (auth)

25874 MEASUREMENTS OF NEUTRAL-HYDROGEN ABSORPTION IN THE SPECTRA OF FOUR PULSARS. **Gordon, Kurtiss J.; Gordon, Courtney P. (National Radio Astronomy Observatory, Green Bank, W. Va.). Astrophys. Lett.; 5: 153-6 (Apr 1970).**

Upper limits are placed on the strength of the 21-cm line absorption of the signals from four pulsars at low galactic latitudes. On a 2σ basis, the limits are: NP 0527, $\tau \lesssim 0.3$; PSR 0833-45, $\tau \lesssim 0.08$; PSR 1929 + 10, $\tau \lesssim 0.12$; and JP 1933, $\tau \lesssim 0.8$. The apparent lack of absorption in these observations suggests that many of the absorption lines found in the spectra of other radio sources are produced by dense, cool clouds of neutral hydrogen smaller than the angular size of the radio sources. (auth)

25875 ELECTRON TEMPERATURES OF H II REGIONS. **Shaver, P. A. (Univ. of Sydney). Astrophys. Lett.; 5: 167-72 (Apr 1970).**

Electron temperatures are determined from 85-MHz continuum observations for eleven nebulae. Evidence obtained from these and other radio-frequency continuum observations concerning the electron temperatures of H II regions is summarized; generally, the temperatures are considerably less than 10^4 °K, and range from 4,000 to 10,000°K in different nebulae, in agreement with theoretical expectations and other methods of temperature determination. (auth)

25876 3C 386: RADIO GALAXY OR SUPERNOVA REMNANT. **Mackay, Craig D. (Cavendish Lab., Cambridge, Eng.). Astrophys. Lett.; 5: 173-6(Apr 1970).**

Recent radio observations of 3C 386 support the suggestion of Pskovskii that it is the remnant of a Crab-like supernova and not an external galaxy as it was originally identified. It is shown, however, that it is still not possible to decide which interpretation is correct. (auth)

25877 MEASUREMENTS OF THE LINEAR POLARIZATION OF SEVEN PULSARS AT 11-CM WAVELENGTH. **Morris, D.; Schwarz, U. J.; Cooke, D. J. (CSIRO, Sydney). Astrophys. Lett.; 5: 181-6(Apr 1970).**

Simultaneous measurements have been made of the first three Stokes parameters specifying the linear polarization of the 11-cm radiation from seven pulsars. The results are averages over at least 500 pulses. The variation of position angle of polarization during the pulse is compared with the predictions of Komesaroff (1970). The data support the view that the radiation from some pulsars, PSR 2045–16 in particular, is beamed into a hollow cone centered on a magnetic pole. (auth)

25878 IMPROVED POSITIONS AND PERIODS FOR FIVE SOUTHERN PULSARS. **Morris, D.; Schwarz, U. J.; Slee, O. B. (CSIRO, Sydney). Astrophys. Lett.; 5: 187-8(Apr 1970).**

More accurate declinations and periods have been found for five Molongio pulsars, using a multi-period integration technique. (auth)

25879 A 408-MHz SURVEY OF THE GALACTIC ANTICENTRE REGION. **Haslam, C. G. T. (Univ. of Manchester, Eng. Nuffield Radio Astronomy Labs., Jodrell Bank, Eng.); Quigley, M. J. S.; Salter, C. J. Mon. Notic. Roy. Astron. Soc.; 147: 405-41(1970).**

The 250-foot aperture Mark I radio telescope at Jodrell Bank was used to make a 408-MHz continuum survey of the galactic anticentre region. The telescope resolution was 45 arc minutes. The region surveyed was 04 h. < R.A. < 12 h., –20° < Dec. < + 60° and 00 h. < R.A. < 04 h., +20° < Dec. < + 60°. The contours are presented at intervals of 2°K in beam temperature. The maps are given both in equatorial coordinates and, for the strip $-10° < b^{II} < +10°$, in new galactic coordinates. (auth) (UK)

25880 X-RAY ASTRONOMY. **Pounds, K. A. (Univ. of Leicester, Eng.). Sci. J.; 6: 61-7(Apr 1970).**

Stars that emit most of their radiation in the x-ray region of the spectrum were first discovered in 1962. One of them appears to be 50 times as hot as the Sun, and 1000 times as powerful, although the source of its power remains in doubt. (auth) (UK)

Solar Phenomena

Refer also to abstract 26367.

25881 (BNL-tr-340) THERMONUCLEAR REACTIONS IN THE SUN'S INTERIOR AND THE SOLAR NEUTRINOS. **Kocharov, G. E.; Starbunov, Yu. N. (Akademiya Nauk SSSR, Leningrad. Fiziko-Tekhnicheskii Institut). Translated by S. J. Amoretty (Brookhaven National Lab., Upton, N. Y.), from a Russian report. 10p. Dep. CFSTI.**

The possibility of a decreased solar neutrino flux based on a hypothesis of the existence of a fairly large quantity of ^{3}He in the Sun's composition and on the existence of a new mechanism for the production of energy in the Sun's interior is considered. (W.D.M.)

25882 (CSIRO-Trans-9644) STRUCTURE AND VARIATIONS OF THE SOLAR CORONA. Unsoeld, Albrecht. Translated by A. K. Rothfield (Commonwealth Scientific and Industrial Research Organization, Melbourne, Australia), from Z. Astrophys.; 50: 57-68(1960). 15p. Dep. CFSTI (U. S. Sales Only).

Energy transport is considered for a model solar corona, in an attempt to describe the features of thermal radio-frequency emission, with particular reference to slow variations in slow centimeter radiations. (Australia)

25883 (CSIRO-Trans-9684) IONIZATION OF INTERPLANETARY GAS. Livshits, M. A. Translated by A. K. Rothfield (Commonwealth Scientific and Industrial Research Organization, Melbourne, Australia), from Astron. Tsirk.; No. 418, 1-3(Apr 1967). 3p. Dep. CFSTI (U. S. Sales Only).

The state of H and He ionization in a moving cloud isolated from the corona, taking into account the possibility of electron shock ionization, is greatly increased at high temperatures. Simultaneous observation of H and He does not require the introduction of different temperature elements. (Australia)

25884 (CSIRO-Trans-9864) PROPAGATION AND DISSIPATION OF WAVES IN THE CHROMOSPHERE. Dubov, E. E. Translated by M. A. Hintze (Commonwealth Scientific and Industrial Research Organization, Melbourne, Australia), from Izv. Krym. Astrofiz. Observ.; 23: 362-8(1960). 9p. Dep. CFSTI (U. S. Sales Only).

Different types of waves, originating during the passage through the chromosphere of acoustic noises generated in the solar convective zone, are considered. It is shown that the magnetic field, when taken into account, does not essentially change the estimate of the value of energy, produced during the dissipation of waves in the chromosphere, which the author found (Izv. Krym. Astrofiz. Obs., 22: 101, (1960)). (Australia)

25885 PROPOSAL FOR A SOLAR MAGNETOGRAPH. Semel, M. (Observatoire, Meudon, France). Astron. Astrophys.; 5: 330-2(Apr 1970).

A proposal for a magnetograph which should solve the whole problem of calibration is advanced. In fact calibration becomes almost banal, and is almost independent of line formation. A standard magnetograph could be modified for use of this method with very little difficulty. (auth)

25886 IONIC COMET TAILS AND THE DIRECTION OF THE SOLAR WIND. Brandt, John C. (Goddard Space Flight Center, Greenbelt, Md.); Hardorp, Johannes. Astron. Astrophys.; 5: 322-4(Apr 1970).

Schlosser and Hardorp have interpreted the waviness of tail rays in Comet Morehouse (1908 III) in terms of fluctuations in the direction of the solar wind, which they found much smaller than expected from satellite measurements in the ecliptic plane. Their conclusion that this is due to Morehouse's high heliographic latitude conflicts with measurements of the gross orientations of ionic comet tails. Two alternative explanations are offered. (auth)

25887 DETERMINATION OF OSCILLATOR STRENGTHS FROM FREE BURNING ARCS. Takens, R. J. (Univ. of Amsterdam). Astron. Astrophys.; 5: 244-63(Apr 1970).

A number of discrepancies between the oscillator strengths given by Corliss and Bozman (1962) and by other authors have been found in recent years. To solve these problems the line emission of free-burning arcs is studied in detail. The following effects are discussed: persistence of the atoms in the arc, departures from local thermodynamic equilibrium, arc structure, and self-absorption. Application of the resulting reduction procedure to the intensities given by Meggers et al. (1961) leads to sometimes very large corrections to the oscillator strengths from Corliss and Bozman. The errors, which have been noticed previously in these oscillator strengths, are explained and removed. Some inconsistencies in other sets of oscillator strengths are also explained: the most important is a temperature error in Corliss and Warner (1964), which was already noticed by various authors. The most striking result is the large correction for the absolute scale of Fe I and many other elements. These corrections remove the notorious discrepancy between coronal and photospheric abundance of Fe and Ni in the Sun. A summary of the proposed correction to the table by Corliss and Bozman is given. (auth)

25888 LATITUDE DISTRIBUTION OF MAGNETICALLY CLASSIFIED SUNSPOT GROUPS AND THEIR ASSOCIATED SOLAR FLARES. Greatrix, G. R. (Teesside Polytechnic, Eng.). Astron. Astrophys.; 5: 171-6(Apr 1970).

A statistical analysis is carried out of data relating to more than 6500 solar flares and their associated spot groups from the maxima of the 18th and 19th solar cycles. There is strong evidence to support the hypothesis that the latitude distributions of solar flares are skewed relative to their associated spot group latitude distributions and that the direction of skew is dependent on the magnetic classification of the spot groups. For a given magnetic classification the direction of skew appears to remain the same for successive cycles. The degree of relative skew is independent of flare intensity. (auth)

25889 CORRELATION BETWEEN SUDDEN PHASE ANOMALIES AND SOLAR MICROWAVE RADIO BURSTS. Kaufmann, P.; Mendes, A. (Mackenzie Univ., Sao Paulo, Brazil). J. Atmos. Terrest. Phys.; 32: 427-32(Mar 1970).

More than two hundred SIDs were observed as vlf phase anomalies (SPA) at times when measurements were being made of solar radio noise at 7 GHz. The SPAs (99%) were correlated with microwave solar events. The SPAs are usually smooth and do not show structure corresponding to that in many of the associated radio bursts. A linear correlation coefficient of 0.6 was found between the mean flux of solar bursts and the "importance" of the SPAs as measured in terms of the phase change divided by the length of the transmission path. The SPAs show only very small dependence on the solar zenith angle. (auth) (UK)

25890 THE STRUCTURE, POLARIZATION, AND SPATIAL RELATIONSHIP OF SOLAR RADIO SOURCES OF SPECTRAL TYPES I AND III. Kai, K. (CSIRO, Sydney). Solar Phys.; 11: 456-66(Mar 1970).

Recent high-resolution observations of the Sun made at 80 MHz with the Culgoora radioheliograph are described. In many cases the sources of Type I storms show bipolar structure, the two components being spatially separated by about 3' arc and strongly circularly polarized in opposite senses. Similar behavior was found for stationary Type IV bursts, which appear indistinguishable from Type I storms on the heliographic records. On the other hand the sources of the weakly polarized Type III bursts show uni-polar structure. The latter avoid the precise locations of Type I sources even when they are associated with the same active center. It is suggested that the Type I storms originate in strong magnetic fields above sunspots while the Type III bursts originate in weak magnetic fields outside the strong-field regions, possibly in neutral sheets. (auth)

25891 GYRO-SYNCHROTRON EMISSION IN A MAGNETIC DIPOLE FIELD FOR THE APPLICATION TO THE CENTER-TO-LIMB VARIATION OF MICROWAVE IMPULSIVE BURSTS. Takakura, Tatsuo; Scalise, Eugenio Jr. (Tokyo Univ.). Solar Phys.; 11: 434-55(Mar 1970).

In order to interpret the observed center to limb variations of spectrum and polarization of microwave impulsive bursts, gyro-synchrotron emission from nonthermal electrons trapped in a magnetic dipole field is computed. The theoretical spectrum and polarization are consistent with observed ones if one puts an outer boundary of the radio source at a layer of 100 to 60 G or $(7 \text{ to } 9) \times 10^4$ km in height. Rather small observed center–limb variations in intensity and polarization are attributed to the distribution of θ, an angle between the magnetic field and the direction of observer, in the radio source emitting the burst, though the intensity and polarization depend strongly on θ especially at small values of θ. (auth)

25892 THE FLARES OF JULY 6 AND 8, 1968. Fortini, T.; Torelli, M. (Osservatorio Astronomico, Rome). Solar Phys.; 11: 425-33(Mar 1970).

From an analysis of the flares of July 6, 1968 and July 8, 1968 the following points emerge: (1) The limb flare of July 6 was observed in white light for approximately ten minutes during the maximum emission of the electromagnetic radiations. This observation fits the preceding observations of white light flares. The radio flux and radio spectrum hint to the nature of a PF. Corpuscular radiation up to more than 190 MeV has been detected from the spacecraft, Pioneer 6 and Pioneer 7. (2) The region of the proton flare was characterized by the presence of a Delta magnetic configuration very probably due to the interaction of two different solar centers. This circumstance is quite common in the elaboration of the most active regions. (3) The flare of July 6 was followed on July 8 by a similar event both for the optical appearance and for the associated electromagnetic radiation. (4) The flare of July 8 showed characteristics of the proton flares: coverage of the spots, scission in two ribbons, outstanding radio microwave emission, type IV burst, U radio spectrum etc. . . . , however it was not followed by a particle flux at the Earth (PCA) or measured in space by the satellites. (auth)

25893 MOTION OF ASCENDING PROMINENCES. Westin, H. (Swedish Astrophysical Station, Anacapri, Italy); Liszka, L. Solar Phys.; 11: 409-24(Mar 1970).

Apparent motions of a number of ascending prominences of the limb-SD type (sudden disappearances) are investigated. The direction, the velocity of ascent, and the correlation with flares are studied. The maximum velocity, which seems to deviate systematically from the radial direction, increases with height and shows a clear dependence on the distance to an initiating flare and its importance. A good correlation between ascending prominences and solar radio emission has been found. (auth)

25894 ON POLARIMETRY IN SOLAR ACTIVE REGIONS. II. SELECTION OF LINES; INTERPRETATION OF POLARIMETRIC DATA. Wiehr, E. (Univ., Goettingen, Ger.). Solar Phys.; 11: 399-408(Mar 1970).

The usefulness of magnetically sensitive iron lines Fe λ5250.2, 6173.3, and 6302.3 for solar polarimetry is investigated. The line-to-continuum absorption coefficient η_0 for Fe λ5250.2 depends strongly on temperature variations. Thus a photospheric calibration of polarimeter signals cannot be used for the different parts of an active region. This is also true for the Doppler calibration of 'longitudinal magnetographs'. Fe λ6302.5 is shown to be useful for polarimetry in active regions. A Milne–Eddington approximation is possible so that Unno's formulae are sufficient for the interpretation of polarimetric data. The ambiguity of the azimuth of the linear polarization prevents the determination of the 'true' field structure with respect to the solar surface. The magnetic flux cannot be determined outside the disc center without making assumptions for the unknown field structure. This determination is possible only for single stable sunspots; for irregular active regions the field configuration remains ambiguous even at the disc center. (auth)

25895 NEW $^{13}C^{14}N$ SEARCH REGIONS IN THE SOLAR SPECTRUM. Fay, Theodore D.; Wyller, Arne A. (Franklin Inst., Swarthmore, Pa.). Solar Phys.; 11: 384-7(Mar 1970).

Ten new rotational line positions, due to the (0,0) red $^{13}C^{14}N$ band, are calculated to fall squarely within continuum regions 1 to 2 Å wide in the near-infrared solar spectrum 10,990 to 11,630. Precision observations of the isotopic line strengths in this spectral region, albeit difficult, should resolve the present ambiguity in the blue–violet observations of whether or not the solar $^{12}C/^{13}C$ ratio is equal to or larger than the terrestrial ratio. (auth)

25896 OBSERVATIONS OF THE INFRARED TRIPLET OF SINGLY IONIZED CALCIUM. Linsky, Jeffrey L. (Univ. of Colorado, Boulder); Teske, Richard G.; Wilkinson, Carol W. Solar Phys.; 11: 374-83(Mar 1970).

Observations of the Ca II infrared triplet (8498, 8542, and 8662 Å) at three positions on the solar disk are presented to make possible direct analyses of the lines and comparisons with theoretical computations. The source functions for the two strongest lines (8542 and 8662 Å) are equal at those heights corresponding to the wings of the lines ($|\Delta\lambda| > 0.4$ Å) but not to those of the cores. It is suggested that the apparent source function inequality in the cores is due to limb darkening caused by inhomogeneities in the chromosphere. (auth)

25897 ON THE RELATIVE RESIDUAL INTENSITIES OF THE CALCIUM H AND K LINES. Linsky, Jeffrey L. (Kitt Peak National Observatory, Tucson, Ariz.). Solar Phys.; 11: 355-73 (Mar 1970).

The solar Ca II H and K lines were observed to obtain well-calibrated ratios of their core residual intensities. From three independent calibrations, one using a standard lamp, it was concluded that the residual intensity ratio $r(K_3)/r(H_3)$ is 1.048 ± 0.03 in the quiet chromosphere and 1.20 ± 0.03 in a plage region. These ratios correspond closely to those observed in stars with quiet and active chromospheres, respectively. For a chromospheric model suggested by the calcium lines and a four-level Ca II ion, H and K lines profiles were computed varying the direct collisional coupling and indirect radiative and collisional coupling via the 3 ^2D level. It was concluded that enhanced chromospheric activity in the Sun and late-type stars results more from a steepening of the chromospheric thermal gradient than from a change in density. (auth)

25898 EMISSION CORES IN H AND K LINES. V. ASYMMETRIES IN K_2 AND K_3. Athay, R. Grant (High Altitude Observatory, Boulder, Colo.). Solar Phys.; 11: 347-54(Mar 1970).

Enhancement of the violet K_2 emission peak results when the atmospheric layers at heights where K_3 forms are moving downward with velocities of 10 to 20 km/sec or when the K_2 layers and those immediately below are moving upward with velocities of 3 to 7 km/sec. Evidence favoring the former alternative is cited. (auth)

25899 THE POLARIZATION OF SOLAR RADIO EMISSION AT 74 MHz: MAY 18–26, 1967. Harvey, G. A.; McNarry, L. R. (National Research Council, Ottawa). Solar Phys.; 11: 467-96(Mar 1970).

The passage of McMath plage region 8818 over the visible solar disk resulted in extensive meter-wavelength activity of spectral Types I, II, III, and IV. The activity at 74 MHz and its polarization were observed with a narrow-band (10 kHz) time-sharing radio polarimeter. Newly adopted data recording and processing techniques have enabled time histories of the polarization characteristics of the solar emission to be obtained with a time resolution of ¼ second. The polarization patterns for all the major activity in the May 18–26 period are described. They exhibit considerable variety in the degree and ellipticity of the polarization observed during both short-lived bursts and long-enduring periods of activity. Both simple and complex patterns were seen when changes in the sense of polarization of the solar emission occurred. Methods used to determine the polarization characteristics of the solar emission in the presence of galactic emission and to resolve the complexities of the solar emission itself are illustrated. (auth)

25900 CORONAGRAPH OBSERVATIONS OF THE CORONAL CONDENSATION OF 4 FEBRUARY 1962. Zirin, H. (Carnegie Institution of Washington, D. C.). Solar Phys.; 11: 497-512(Mar 1970).

Climax coronagraph observations of the accessible Fe lines, as well as the Ca XV λ 5694 line at the time of the 1962 total eclipse, are analyzed. The spectra show that the ionization equilibrium of iron is not substantially changed in an intense coronal condensation, at least for the stages X through XV. The only exception is Fe XV λ 7059, for which density effects are important. The stability of the ionization distribution is explained by the dynamic nature of the Fe ionization, with ions entering on the high side (Fe XVI and up) due to rapid heating and then cooling through the visible stages. Comparison of the ionization distributions inferred from radiative and collisional excitation of the iron lines shows that the excitation must be by collisions everywhere at the heights examined (less than 50,000 km). The iron abundance in the corona is found to be 10^{-4} that of hydrogen, but this figure would be reduced by the amount of cyclic excitation. The peak electron density in the condensation is 8×10^9, and the peak value of the λ 5694 line/continuum ratio is 2.5, in good agreement with calculations by Chevalier and Lambert. The ratio of the infrared Fe XIII lines is measured along the limb and found to vary with electron density as expected, the 10,747/10,798 ratio is 7 or less at densities much below 10^9 and saturates at a value of 2 for densities above that amount. (auth)

25901 EXTREME ULTRAVIOLET OBSERVATIONS OF ACTIVE REGIONS IN THE CHROMOSPHERE AND THE CORONA. Noyes, Robert W. (Smithsonian Astrophysical Observatory, Cambridge, Mass.); Withbroe, George L.; Kirshner, Robert P. Solar Phys.; 11: 388-98(Mar 1970).

New observations of solar active regions were obtained by the Harvard College Observatory euv spectroheliometer aboard the OSO-IV spacecraft. From the observations the enhancement in active regions of the emission from ions formed at various temperatures in the chromosphere and corona were determined. The results are in accord with a simple model of active regions, for which the active region pressure is about 5 times the quiet Sun pressure; the temperature gradient in the transition zone is about 5 times the quiet Sun value; and the coronal temperature above active regions is slightly increased. (auth)

25902 COMMENTS ON THE DISCOVERY OF THE DARK BAND IN THE Hα SOLAR CHROMOSPHERE. White, O. R. (High Altitude Observatory, Boulder, Colo.); Bhavilai, Rawi. Astrophys. Lett.; 5: 137-40(Apr 1970).

The dark band in the low chromosphere described by Loughhead (1969) is shown to arise from unwanted photospheric light. (auth)

25903 EMPIRICAL DAMPING, AND THE SOLAR ABUNDANCE OF IRON. Cowley, Charles (Univ. of Michigan, Ann Arbor). Astrophys. Lett.; 5: 149-50(Apr 1970).

A solar iron-to-hydrogen ratio, as well as a new system of oscillator strengths for Fe I lines, has been determined at Kiel. The derived values are not consistent with laboratory measurements of line broadening by neutral atoms. If the gf values and the solar iron-to-hydrogen ratio determined at Kiel are correct, the simple impact theory of van der Waals broadening is also a fair approximation. For Fe I lines it is shown that this agreement must be accidental. (auth)

25904 DIFFERENCE OF THE TURBULENT VELOCITIES IN THE ACTIVE AND UNPERTURBED PHOTOSPHERE. Badalyan, O. G.; Livshits, M. A. (Shternberg State Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.); 13: 811-14(Mar-Apr 1970).

Translated from Astron. Zh.; 46: 1035-9(Sep-Oct 1969).

Turbulent velocities ξ in the facula and unperturbed photosphere are compared. For lines with relatively deep formation levels the velocity ξ in the facula is about 0.02 km/sec (or about 10% of ξ) greater than ξ in the unperturbed photosphere. (auth)

25905 POLARIZATION MEASUREMENT OF CaI λ 4227 RADIATION FROM A SOLAR PROMINENCE. Nikol'skii, G. M.; Khetsuriani, Ts. S. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Sov. Astron. AJ (Engl. Transl.); 13: 815-20(Mar-Apr 1970).

Translated from Astron. Zh.; 46: 1040-6(Sep-Oct 1969).

From polarization photographs of quiescent prominences in the Ca I λ 4227 line at heights of 15 to 20 sec, an estimate of the degree of polarization P was made, of roughly 4%. In the case of photoexcitation of the λ 4227 line, polarization of roughly 20% would be expected. From the half-width of the λ 4227 line, the turbulent velocity is found to be 4 km/sec and the radial velocity ≤ 2 km/sec. Depolarization might occur by two processes: by a change in the orientation of the excited atoms because of Larmor precession in a magnetic field $H \geq 25$ G, and by excitation due to collisions with electrons. From an examination of the ionization equilibrium, a relationship is found between the degree of ionization N (Ca II)/N (Ca I) and n_e and T. The degree of ionization is determined from the equivalent widths of the λ 4227 line of Ca I and the λ 4216 line of Sr II. If $H < 25$ G, the probability of collisional excitation according to the observational data is $n_e W_{12} = 8 \cdot 10^4$ sec^{-1}, which is four times higher than the probability of photoexcitation. In this case, $n_e = 2 \cdot 10^{11}$ cm^{-3} and $T = 2 \cdot 10^4$°K. If $H \geq 25$ G, the true temperature for quiescent prominences is T = 5 to $10 \cdot 10^3$°K, and $n_e \approx 10^{11}$. The latter case is the more probable. (auth)

25906 ELECTROMAGNETIC ACCELERATION OF CHARGED PARTICLES IN NONSTATIONARY SUNSPOT MAGNETIC FIELDS. Kolpakov, P. E. Sov. Astron. AJ (Engl. Transl.); 13: 821-7(Mar-Apr 1970).

Translated from Astron. Zh.; 46: 1047-56(Sep-Oct 1969).

An analysis was made of the conditions and possibilities for acceleration of nonrelativistic charged particles in time-varying (growing) sunspot magnetic fields. The energy losses of the accelerated particles were considered, and the conditions were established such that the electrons and protons in the chromospheric–coronal plasma could be accelerated to an energy $W_\perp(t) = W_\perp(0)\,B(t)/B(0)$. (auth)

25907 NATURE OF THE INHOMOGENEOUS STRUCTURE OF THE CIRCUMSOLAR PLASMA. Baikov, I. S.; Lotova, N. A. (Lebedev Inst. of Physics, Moscow). Sov. Astron. AJ (Engl. Transl.); 13: 828-32(Mar-Apr 1970).

Translated from Astron. Zh.; 46: 1057-63(Sep-Oct 1969).

An analysis was made of the various types of instability that can occur under the conditions prevailing in the circumsolar plasma. Drift instability, slipping instability, and the instability due to an anisotropic temperature distribution were considered. The fine-scale structure observed by radio techniques may arise from different types of instability in different regions of the circumsolar plasma. (auth)

25908 EXCITATION, IONIZATION, AND RECOMBINATION RATES FOR IONS IN THE SOLAR-CORONA PLASMA. Beigman, I. L.; Vainshtein, L. A.; Vinogradov, A. (Lebedev Inst. of Physics, Moscow). Sov. Astron. AJ (Engl. Transl.); 13: 775-9(Mar-Apr 1970).

Translated from Astron. Zh.; 46: 985-92(Sep-Oct 1969).

A discussion is given of the excitation, ionization, photorecombination, and dielectronic recombination processes of highly ionized atoms in collision with electrons. Simple two-parameter approximation equations are proposed for the rates of these processes, assuming a Maxwellian distribution for the electrons. The values of the parameters are tabulated for excitation of H- and He-like ions, and for ionization and recombination of ions belonging to the isoelectronic sequences from H to Ne. The parameters were evaluated by the method of least squares, using cross sections computed numerically. Ionization-equilibrium curves are computed from these cross sections for the ions responsible for the x rays emitted by the solar corona in the 3- to 35-Å wavelength range. (auth)

25909 OBSERVATIONS OF SCATTER-FREE PROPAGATION OF ~40-keV SOLAR ELECTRONS IN THE INTERPLANETARY MEDIUM. Lin, R. P. (Univ. of California, Berkeley). J. Geophys. Res.; 75: 2583-6(1 May 1970).

A number of ~40-keV solar-flare electron events of short duration were observed by the University of California experiment aboard the IMP 4 satellite. These events had almost equal rise and decay times of 5 to 10 min, and transit times of these particles from the Sun to the Earth are ~25 min. The most probable distance traveled for these electrons is only ~1.5 AU, compared with typically ~10 for protons and 1.2 for the length of a smooth spiral interplanetary field line from the Sun to the Earth. The bulk of the electrons travel <2.0 AU. It is concluded that the electrons have experienced little or no scattering in their propagation through the interplanetary medium. (auth)

25910 STATISTICAL SIGNIFICANCE OF THE PROPOSED HELIOGRAPHIC LATITUDE DEPENDENCE OF THE DOMINANT POLARITY OF THE INTERPLANETARY MAGNETIC FIELD. Wilcox, John M. (Univ. of California, Berkeley). J. Geophys. Res.; 75: 2587-90(1 May 1970).

The polarity of the interplanetary magnetic field during the interval discussed by Rosenberg and Coleman (1969) is shown. It is also shown that the interplanetary field sector pattern usually changes little from one solar rotation to the next, and that individual sectors typically persist for a number of months. Thus, individual consecutive solar rotations do not represent statistically independent examples of the proposed effect. In an approach that is possibly overly conservative, it is assumed that each half-year interval is an independent example. (W.D.M.)

25911 COLLISIONLESS SOLAR WIND. I. CONSTANT ELECTRON TEMPERATURE. Hollweg, Joseph V. (Max-Planck-Institut fuer Physik und Astrophysik, Garching, Ger.). J. Geophys. Res.; 75: 2403-18(1 May 1970).

A two-fluid model for the solar wind is discussed, in which the electrons, at constant temperature, are treated hydrodynamically and the protons are assumed to become collisionless, at a distance from the Sun at which they are already supersonic. A radial magnetic field is included, with radial gravitational and electric fields; the electric field arises from the condition of quasi neutrality and is an important feature of the model. Quantities such as bulk velocity, concentration, and proton temperatures parallel and perpendicular to the magnetic field are discussed directly in terms of the proton distribution function; viscosity and heat conduction are thus automatically included. The principal result is that if the electron temperature in the vicinity of the point where the electrons become collisionless (10 to 20 $R_\odot$) is of the order 10^6 °K, the flow velocity at the orbit of the Earth is in excess of 300 km/sec, and the average proton temperature is of the order of 10,000°K. Both of these figures are higher than those obtained by the two-fluid hydrodynamical model. The velocity far from the base of the model varies as $T_e^{1/2}$ and is relatively insensitive to temperature or velocity at the base or to the location of the base. The thermal anisotropy of the protons, $T_{\|}/T_\perp$, is predicted to be about 50. (auth)

25912 EFFECT OF VISCOSITY AND ANISOTROPY IN THE PRESSURE ON THE AZIMUTHAL MOTION OF THE SOLAR WIND. Weber, E. J. (Kitt Peak National Observatory, Tucson, Ariz.); Davis, L. Jr. J. Geophys. Res.; 75: 2419-28(1 May 1970).

A steady-state axially symmetrical model for the flow of the solar wind near the equatorial plane is developed. The radial motion is regarded as known, and the azimuthal motion is investigated, allowing for magnetic forces, viscosity (as modified by the magnetic field), and anisotropic pressure. It is shown that to obtain a smooth continuous solution the constant of integration has to be determined, not from a boundary condition at the Sun, but by the behavior of the solution near the critical radius r_A, where the radial Mach number is unity. The viscosity considerably increases the tendency toward corotation in the region between 5 $R_\odot$ and 1 AU. The azimuthal velocity predicted near the Earth is of the order of 6 km/sec for what may be regarded as typical conditions (temperature of 2×10^5 °K and a radial wind velocity of 400 km/sec), whereas the velocity is 1 km/sec for a nonviscous isotropic model. (auth)

25913 ANOMALOUS RHENIUM ISOTOPIC RATIO IN THE SOLAR WIND: DETECTION AT THE NANOGRAM LEVEL. Morgan, J. W. (Univ. of Kentucky, Lexington). Nature (London); 225: 1037-8(14 Mar 1970).

An apparent anomaly in ^{187}Re–^{187}Os cosmochronology was reported by Clayton (Nature, 224: 56(1969)) and it was shown that this could be resolved if the half-life of ^{187}Re were significantly shortened in a stellar environment. The solution might lie in the bound β-decay process, which is energetically feasible for the weak ^{187}Re transition, and ionisation of Re in the outer solar convective zone increases the number of vacant bound states available. Clayton suggested a reduction in the total half-life of ^{187}Re from 43×10^9 to about 3×10^9 years. It might therefore be expected that the ^{187}Re/^{185}Re ratio in the solar wind would be between a half and a third of that observed terrestrially, and it was suggested that this hypothesis could be tested by measuring the isotopic ratio of Re in the surface layer of an old part of the lunar regolith. A simple and sensitive method to detect the expected isotopic anomaly is suggested in the present communication. The solar wind flux of Re is stated to be 10^{-3} atoms/cm^2/sec, and this deposits ~10^{-8} g Re/cm^2 in 10^9 years. A preliminary examination of Apollo II samples showed that Re is below the spectrographic detection limit. In the present discussion it is assumed that the Re content of lunar material might resemble that of terrestrial basic rocks, or that of the achondrites, and an upper limit for lunar material might appear to be $\sim 10^{-9}$/g. Estimates of the concentration of solar-wind Re depend on the model used. Even with the short solar-wind exposure time of 10^6 years, a Re isotopic anomaly of 1% or more could be expected; the exposure time, however, might well be much larger and a surface isotopic anomaly of 10% or more might occur. Solar-wind Re will be more abundant relative to normal Re in the lunar fine-grained soil. The nuclear characteristics of Re are very favourable for its determination by neutron-activation analysis and both naturally occurring isotopes yield radionuclides of convenient half-life; it is thus possible to determine the isotopic ratio with good sensitivity. The ratio can be derived by comparison of the decay curves of a radiochemically purified Re source from a lunar specimen with that of a standard of normal isotopic ratio. If the expected isotopic anomaly can be demonstrated it would be of considerable value in determining relative deposition rates of the lunar regolith and ablation rates of lunar rocks. (UK)

25914 ROCKET UV FLASH SPECTRA FROM THE SOLAR ECLIPSE OF MARCH 7, 1970. Spear, R. J. (Imperial Coll. of Science and Tech., London); Garton, W. R. S.; Morgan, J. F.; (and others). Nature (London); 226: 249-50(18 Apr 1970).

It is stated that flash spectra of the total solar eclipse throughout all its phases were obtained in the extreme uv for the first time from an Aerobee 150 rocket launched into the total solar eclipse passing over the NASA launch range at Wallops Island, Virginia. A sequence of 50 spectra was recorded over a period of 180 sec in the range 850 to 2150 Å. The spectra were spatially resolved and showed images of the eclipse in each spectral line. A description is given of the whole experiment. Several prominences and a plage region were clearly visible in Lyman α, and their spectra were isolated and spatially resolved throughout the whole sequence. The Lyman-α images are of particular interest since structure and emission can be seen out to 1.3 solar radii, which is well beyond the emission from the coronal forbidden lines of Fe XII at 1242 and 1350 Å. Preliminary estimates allow radiative recombination, electron excitation, and dust scattering to be eliminated as possible mechanisms to explain the observed intensity of coronal Lyman α. Thomson scattering can also be eliminated from lack of Doppler broadening of the lunar disk image considerations. It is concluded that the observed intensity is due to resonance scattering of the intense eclipsed Lyman-α radiation by residual neutral H atoms in the corona. This "Lα corona" therefore reflects the distribution of neutral hydrogen and has an intensity in the inner corona of the order of 10^{-3} of the low-lying chromospheric Lyman α. (UK)

25915 FINE STRUCTURE OF THE FLARE OF JUNE 9, 1968. Giovanelli, R. G. (CSIRO, Sydney). Proc. Astron. Soc. Aust.; 1: 184-5(Mar 1969).

A class 2 flare began on June 9, 1968 in the active region near 17°N 40°E, at about 00h 15m U.T., maximum 00h 37m, terminating about 02h 30m. The event as observed at Culgoora with the five-inch flare-patrol and twelve-inch chromospheric telescopes is described. (W.D.M.)

25916 CORRELATED BURSTS AT DISTANT SOURCES ON THE SUN. Kai, K. (CSIRO, Sydney). Proc. Astron. Soc. Aust.; 1: 186-8(Mar 1969).

Since the start of high-resolution observations with the radioheliograph at Culgoora it has been noted that some bursts that occur from separate active regions would be physically correlated. Some examples are presented of correlated bursts from separate distant sources that (i) occur suddenly in long quiet periods and (ii) are much stronger than the integrated quiet Sun. (W.D.M.)

25917 OBSERVATION OF STRONG CIRCULAR POLARIZATION IN A MOVING TYPE-IV BURST. Kai, K. (CSIRO, Sydney). Proc. Astron. Soc. Aust.; 1: 189-91(Mar 1969).

Moving type-IV bursts have been attributed to synchrotron radiation from electrons with energy ~3 MeV radiating in weak magnetic fields (~1 G) high in the corona. A description is given of 80-MHz radioheliograph observations of an outburst in which it was possible to isolate the moving type IV source and demonstrate that its circular polarization was strong (~80%). Hence, it is shown that the energy of the radiating electrons cannot exceed 6×10^5 eV. (W.D.M.)

25918 THE HEIGHTS OF SOLAR RADIO SOURCES AT 1424 AND 696 MHz. Cole, D. G.; Mullaly, R. F. (Univ. of Sydney). Proc. Astron. Soc. Aust.; 1: 192-4(Mar 1969).

The heights of solar radio sources at 1424 and 696 MHz were measured during the years 1965 and 1966. Solar activity at this time was near minimum, which made it easier to resolve the individual sources. The period of observation was continuous. (W.D.M.)

25919 SOLAR RADIO BURSTS AT 21-cm WAVELENGTH OBSERVED WITH HIGH ANGULAR RESOLUTION. Mullaly, R. F.; Nelson, G. J. (Univ. of Sydney). Proc. Astron. Soc. Aust.; 1: 194-5(Mar 1969).

Among short bursts observed (about 12 events, duration <2 min, peak flux 50 to 200 units), a few gave deeply modulated fringes on the longer baseline, the rest none. An example of the records obtained for a complex burst is shown. All the complex bursts seen (5 events, duration >20 min, peak flux 200 to 500 units) showed fringes at 3800λ spacing during at least part of their lifetime. (W.D.M.)

25920 TEMPERATURE FLUCTUATIONS AND CONVECTIVE MODES IN THE SOLAR PHOTOSPHERE. Wilson, P. R. (Univ. of Sydney). Proc. Astron. Soc. Aust.; 1: 195-6(Mar 1969).

A two-dimensional radiative transfer analysis of data given by Edmonds (Ap. J. Suppl. 6: 367(1962)) on fluctuations in center-limb relative r.m.s. intensity, in terms of fluctuations in horizontal temperature in the solar photosphere shows that the fluctuations increase to a maximum of about 600°K at a depth corresponding to a mean optical depth of 0.7. The results are different to those of Edmonds and give a crude picture of transition from predominantly convective transport of energy to predominantly radiative transport in the region from about 320 to 190 km. (Australia)

25921 POWER SPECTRAL ANALYSIS OF CHROMOSPHERIC INHOMOGENEITIES. Cannon, C. J. (Univ. of Sydney). Proc. Astron. Soc. Aust.; 1: 197-8(Mar 1969).

Observations with a 16-inch coronagraph coupled to a high-dispersion Littrow spectrograph were made of the central intensity variation in the Mg B and Na D chromospheric lines. The power spectra, in which the frequency is inversely proportional to distance across the disk of the Sun, are given. It is suggested that there are many different structure sizes in the lower chromosphere. For the larger structural sizes the amplitudes at which the peaks in power, at the center of the disk, occur are approximate multiples of $1/\sqrt{3}$. (Australia)

25922 MODEL OF THE MAGNETIZED SOLAR WIND. Urch, I. H. (Univ. of Adelaide). Proc. Astron. Soc. Aust.; 1: 198-9(Mar 1969).

A model of the solar corona is presented in which the Sun rotates and has a general magnetic field which has $B_\theta = 0$ in spherical polar coordinates. The solar wind parameters were evaluated for various boundary conditions, using an iterative technique to solve the system of equations. The flow is discussed for varying coronal conditions. A "best-fit" model was found and approximate power law expressions obtained to show parametric variation effects. The magnetic field is not very different from the Archimedes spiral predicted by Parker (Ap. J. 128: 664(1958)) and causes the angular momentum of the plasma to increase as it recedes from the Sun. A solar wind appears to be an important means by which a star loses angular momentum. (Australia)

Galaxies

25923 (CSIRO-Trans-9718) OBSERVATIONS OF Hα EMISSION IN THE NUCLEUS OF VIR A(M87) RADIO GALAXY. Dibai, E. A.; Esipov, V. F. Translated by A. K. Rothfield (Commonwealth Scientific and Industrial Research Organization, Melbourne, Australia), from Astron. Tsirk.; No. 428, 3-4(Jul 1967). 2p. Dep. CFSTI (U.S. Sales Only).

Observations of M87 at Shternberg Main Astronomical Observatory showed lines at 6585 (Hα) and 6606 (N II). The density $\bar{n}_e$ = 10 to 20 cm^{-3} and mass = 10^5 are in good agreement with Shklovskii's results based on the 3727 (O II) emission. (Australia)

25924 A MODEL OF STELLAR SYSTEM WITH CONSTANT DENSITY IN PHASE SPACE. THE STATIONARY STATE. Doremus, J. P.; Feix, M. R.; Baumann, G. (Univ., Nancy). Astron. Astrophys.; 5: 280-5(Apr 1970). (In French).

The steady state of a collisionless stellar system with spherical symmetry is studied. The distribution function is a function of the two integrals of the motion. A model is introduced for which this distribution function is a constant within a volume of the phase space and zero outside this volume. (This is the "Water Bag" model.) The case of an isotropic velocity distribution is considered and it is shown that the Water Bag model is equivalent to a polytrope with index $n = 3/2$. The next case deals with an anisotropic velocity. It is shown that the equilibrium state in the case of an isotropic velocity distribution corresponds to a minimum of the total energy. This generalizes previous results obtained by Feix, Hohl, and Staton (1969) for one-dimensional plane systems. (auth)

25925 NUMERICAL STUDY OF TWO FAMILIES OF GLOBULAR CLUSTER ORBITS. Innanen, K. A.; Hodder, R. V.; Smith, C. E. (York Univ., Toronto). Astron. Astrophys.; 5: 206-8 (Apr 1970).

Two numerically integrated groups of galactic orbits related to previous calculations (Innanen, 1966a) are described. It is found that periodic or nearly periodic orbits in the $(\overline{\omega} - z)$ plane are a standard feature of these orbits for velocity vectors initially highly inclined to the galactic plane, whereas tube and perhaps box orbits are confined to velocity vectors of low initial inclination to the galactic plane. In the first group, where inclination and angular momentum are held constant, but where energy increases, periodic or nearly periodic orbits and tube-like orbits appear alternately. (auth)

25926 POLARIMETRIC INVESTIGATION OF THE GALAXY NGC 7814. Hagen-Thorn, V. A. Uch. Zab. Leningrad. Gos. Univ., Ser. Mat. Nauk; No. 347, No. 44, 48-54(1969). (In Russian).

The results of the photoelectric and photographic observations of the galaxy NGC 7814 are given. In the region of the dark band, the polarization similar to the interstellar polarization in the Milky Way is found. (auth)

25927 LUMINOSITY FUNCTIONS OF GALAXIES AND NUCLEI OF GALAXIES. Nezhinskii, E. M.; Isipkov, L. P. Uch. Zap. Leningrad. Gos. Univ., Ser. Mat. Nauk; No. 347, No. 44, 92-113(1969). (In Russian).

The luminosity functions for the nuclei of galaxies are derived by a method given previously. It is found that the luminosity functions for the nuclei of galaxies of different types are quite similar. (auth)

25928 COMPACT GALAXIES: A REMARKABLE NEW CATEGORY OF STELLAR SYSTEMS. Richter, Nikolaus (Central Inst. for Astrophysics, Berlin). Jena Rev.; No. 6, 324-9 (1969).

Results presented represent part of an astrophysical statistical research program on the compact galaxies carried out at Tautenburg during the last few years. The Schmidt camera of the Tautenburg 2-m telescope was used. (W.D.M.)

25929 THE ANDROMEDA NEBULA ON TAUTENBURG SCHMIDT PHOTOGRAPHS. Boerngen, Freimut (Central Inst. for Astrophysics, Berlin). Jena Rev.; No. 6, 330-2(1969).

The possibilities, as well as the limits, of the Tautenburg 2-m Schmidt optical system are shown by the example of M31. Several comparisons with other large telescopes are made. (W.D.M.)

25930 INTERSTELLAR DUST. Schmidt, Karl-Heinz. Jena Rev.; No. 6, 332-9(1969).

The nature of the interstellar dust is discussed, and it is concluded that, although the exact properties of the dust remain unclear, the number of types of particles is limited. The effects of the dust on stellar photography and photometry are discussed in some detail. (W.D.M.)

25931 STRUCTURE OF FINE-FILAMENT REFLECTION NEBULAE. Artamonov, B. P. (Shternberg Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.); 13: 769-74(Mar-Apr 1970).

Translated from Astron. Zh.; 46: 978-84(Sep-Oct 1969).

The conditions for the formation of filamentary fine structure in reflection nebulae are discussed. An application of the gutter-instability mechanism at a plasma–plasma interface in a gravity field and in crossed magnetic fields enables the parameters to be evaluated for gas–dust clouds and a galactic spiral arm, such that a system of thin filaments can develop. (auth)

25932 RADIO EMISSION OF NORMAL GALAXIES. Pronik, I. I. (Crimean Astrophysical Observatory, USSR). Sov. Astron. AJ (Engl. Transl.); 13: 747-9(Mar-Apr 1970).

Translated from Astron. Zh.; 46: 951-4(Sep-Oct 1969).

The mass–luminosity relation in the radio range is derived from data for 22 nearby galaxies: $L_r \propto M^{2.1}$ for I and Sc galaxies; $L_r \propto M^{1.5}$ for Sb, SO, and E galaxies. The relation $L_r \propto L_{pg}^2$ holds approximately for normal galaxies, but smoothly approaches a steeper relation $L_r = f(L_{pg})$ in the radio-galaxy region. (auth)

25933 INTERACTION OF THE IONIZING BACKGROUND RADIATION WITH GALAXIES, AND LIMITS ON THE INTERGALACTIC GAS DENSITY. Syunyaev, R. A. (Inst. of Applied Mathematics, Moscow). Sov. Astron. AJ (Engl. Transl.); 13: 729-33(Mar-Apr 1970).

Translated from Astron. Zh.; 46: 929-34(Sep-Oct 1969).

The background x-ray emission influences the physical conditions in the interstellar medium, serving to heat and ionize the gas. The heating prevents the formation of neutral-hydrogen clouds in the space between spiral arms and at the periphery of a galaxy. The presence of helium and heavy elements in the interstellar gas enhances the absorption of x-ray photons. The neutral-hydrogen distribution observed at the periphery of galaxies contravenes the existence of an intergalactic gas having a density exceeding one third the critical density. (auth)

25934 INTERSTELLAR FORMALDEHYDE ABSORPTION NEAR THE GALACTIC CENTER. Gardner, F. F.; Whiteoak, J. B. (CSIRO, Sydney). Astrophys. Lett.; 5: 161-6(Apr 1970).

Observations of formaldehyde absorption at 4829 MHz, with a resolution of 100 kHz, were made at 24 positions in the galactic center region. The results are compared with the corresponding OH and H I data. The radial velocities of the absorption maxima seem to fit continuous sequences in a velocity–longitude diagram and these sequences are interpreted in terms of a kinematic model containing expansion and contraction. (auth)

25935 GALACTIC GAMMA-RAY OBSERVATIONS AND SCATTERING OF ELECTRONS ON THE MILLIMETER RADIATION. Maraschi, L.; Treves, A. (Univ., Milan). Astrophys. Lett.; 5: 177-80(Apr 1970).

The galactic γ-ray flux which can arise by Compton scattering of electrons on the diffuse infrared radiation observed by Shivanandan et al. (1968) is compared with the experimental results of Clark et al. (1968), within the range of values indicated by the experimental errors quoted in both observations. Indications on the thickness of the γ-ray production region are derived from the angular distribution of the anisotropic γ-ray flux, and the possibility is discussed of the existence of a central source and of an extragalactic isotropic component. (auth)

25936 RADIO EMISSION OF NEARBY GALAXIES AT 3.5 CM. Kuril'chik, V. N.; Andrievskii, A. E.; Ivanov, V. N.; Spangenberg, E. E. (Shternberg Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.); 13: 881-2(Mar-Apr 1970).

Translated from Astron. Zh.; 46: 1124-5(Sep-Oct 1969).

Results are reported of a survey of the radio emission from several bright nearby galaxies at 8.5 GHz. (auth)

25937 NEW MASS-LUMINOSITY RELATION FOR ELLIPTICAL GALAXIES. Genkin, I. L.; Genkina, L. M. (Astrophysical Inst., Alma-Ata, USSR). Sov. Astron. AJ (Engl. Transl.); 13: 886-8(Mar-Apr 1970).

Translated from Astron. Zh.; 46: 1128-30(Sep-Oct 1969).

A list of elliptical galaxies is given whose masses have been determined by the same method and in a unified system. The homogeneity of the masses allows some conclusions to be drawn regarding the mass–luminosity relation. (auth)

25938 THE SPACE DISTRIBUTION OF B8–A0 AND EARLY B STARS IN SOME MILKY-WAY FIELDS AT GALACTIC LONGITUDES 15 TO 136°. Grigor'eva, N. B. (Shternberg Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.); 13: 807-10 (Mar-Apr 1970).

Translated from Astron. Zh.; 46: 1029-34(Sep-Oct 1969).

Observations obtained at the Crimean Astrophysical Observatory by several authors, mostly from the Shternberg Astronomical Institute, were reduced to derive the space distribution of type B8–A0 stars in four fields close to the galactic plane. The distribution is given for fields I–IV, together with space densities for four other regions, fields V–VIII. The space distribution of early B stars (B0–B3) is given for fields I–IV. The count of B8–A0 stars may be considered complete to distances of 700 to 800 pc, and for early B stars (except for field VI, where the absorption is small), to 2000 pc. It is shown how the density maximum depends on distance and galactic longitude. (auth)

Cosmology

Refer also to abstracts 26414, 26474, 26475, 26504, and 26508.

25939 THERMODYNAMICS OF STRONG INTERACTIONS AT HIGH ENERGY AND ITS CONSEQUENCES FOR ASTROPHYSICS. Hagedorn, R. (European Organization for Nuclear Research, Geneva). Astron. Astrophys.; 5: 184-205(Apr 1970).

Statistical thermodynamics in a particular form derived from high-energy physics is used to describe the thermodynamical properties of what might have been the Universe before its energy density became much lower than nuclear density. The main features are: even if it started with infinite energy density, it never had a temperature greater than $T_0 = 160$ MeV (1.86×10^{12}°K), which is the universal highest temperature in this theory; for very large energy density the pressure is not, as in usual theories, proportional to the energy density but only its logarithm; inside each elementary volume V_0 ($\approx$ nucleon volume) the energy fluctuates by an amount of the order of the total energy contained in V_0. For infinite energy density this fluctuation does not vanish as in ordinary theories, but tends to $\Delta E/E \sim 0.4$. The conjecture is proposed that smaller but still substantial fluctuations of the baryonic quantum number may go along with the energy fluctuations. (auth)

25940 NONLINEAR LIMIT ON PRIMEVAL ADIABATIC PERTURBATIONS. Peebles, P. J. E. (California Inst. of Tech., Pasadena). Phys. Rev., D; 1: 397-9(15 Jan 1970).

The amplitude of adiabatic perturbations that might have existed in the early universe is limited by the nonlinear transfer of energy to high frequencies. For flat cosmological models, this limit, together with the effect of linear dissipation, yields a residual perturbation in the matter distribution comparable with the semi-empirical estimate of what is needed to produce massive galaxies. (auth)

25941 A HYPOTHESIS FOR THE INITIAL SPECTRUM OF PERTURBATIONS IN THE METRIC OF THE FRIEDMANN MODEL UNIVERSE. Zel'dovich, Ya. B.; Novikov, I. D. (Inst. of Applied Mathematics, Moscow). Sov. Astron. AJ (Engl. Transl.); 13: 754-7(Mar-Apr 1970).

Translated from Astron. Zh.; 46: 960-4(Sep-Oct 1969).

The hypothesis is advanced that at the onset of the cosmological expansion (near the singularity) all types of perturbations in the metric of the Friedmann solution are excited to the same order of magnitude and have the same spectrum. In this event the energy of long-wave gravitational waves at the epoch of the cosmological recombination $p + \bar{e} = H$ will be of the same order as the energy of the sound waves and far greater than the energy of turbulent (vortical) motion. In this wavelength range the energy of the long-wave gravitational waves should vastly exceed the energy of the equilibrium primordial gravitational radiation with $T \approx 1°K$, which would be expected in an unperturbed hot model Universe. (auth)

25942 OBSERVABLE RELATIONS IN A COSMOLOGICAL MODEL UNIVERSE WITH MATTER AND A NEUTRINO BACKGROUND. Finkel'shtein, A. M. (Inst. of Theoretical Astronomy, Leningrad). Sov. Astron. AJ (Engl. Transl.); 13: 758-61(Mar-Apr 1970).

Translated from Astron. Zh.; 46: 965-9(Sep-Oct 1969).

With a Friedmann model Universe containing matter and radiation (presumably neutrino radiation) as a basis, the fundamental relations observable in extragalactic astronomy are derived; apparent bolometric magnitude against redshift, number of galaxies against redshift, and number of galaxies against apparent magnitude. (auth)

25943 CIRCULAR AND RADIAL TRAJECTORIES IN A GENERALIZED SCHWARZSCHILD FIELD. Prepelitsa, B. V. Sov. Astron. AJ (Engl. Transl.); 13: 889-90(Mar-Apr 1970).

Translated from Astron. Zh.; 46: 1130-2(Sep-Oct 1969).

The standard results concerning the motion of test particles in a Schwarzschild field along circular and radial trajectories are partially extended to the cases: 1) cosmological constant $\Lambda \neq 0$; 2) an electrically charged central body. These results have no application to stars. (auth)

25944 ELLIPTICAL COSMOLOGY. Zaikov, Raschko. Izv. Fiz. Inst. Aneb, Bulg. Akad. Nauk.; 19: 109-54(1969). (In German).

In this theory of elliptic cosmology, the fundamental premises are: (1) the Universe is elliptical everywhere and at all times, and (2) distribution of galaxies is homogeneous and isotropic. At the present time, the radius of space curvature increases at a decelerating rate; this hypothesis agrees with new observations and follows from the Friedmann–Einstein nonstatic gravitation equations. The so-called cosmologic lambda constant is zero everywhere and at all times. All physical constants, e.g., speed of light, Planck's constant, electron charge, and Newton's gravitation constant maintain everywhere the same value. The present calculations show that local time must be distinguished from world time that accounts completely for space expansion. Local time measures duration within small confines while world time refers to supermacroscopic events. World time applies to evolution of the Universe and, therefore, does not enter local physical constants and processes. (H.B.G.)

Planetary Phenomena

25945 INTERFEROMETRY OF JUPITER AT 18 MHz WITH A 52800λ BASELINE. Block, W. F. (Florida Presbyterian Coll., St. Petersburg); Paul, M. P.; Carr, T. D.; Lebo, G. R.; Robinson, V. M.; Six, N. F. Astrophys. Lett.; 5: 133-6(Apr 1970).

Millisecond bursts received at 18 MHz during the 1967–1968 apparition of Jupiter were analyzed with a tape-recording fringe interferometer having a baseline of 880 km (52,800λ). The measurements indicated source diameters as small as 0.72 arc sec. No significant difference in the time of arrival of the bursts at the two stations was observed, other than that due to geometry. (auth)

25946 CARBON COMPOUNDS IN APOLLO 11 LUNAR SAMPLES. Nagy, B. (Univ. of Arizona, Tucson); Scott, W. M.; Modzelski, V.; Nagy, L. A.; Drew, C. M.; McEwan, W. S.; Thomas, J. E.; Hamilton, P. B.; Urey, H. C. Nature (London); 225: 1028-32(14 Mar 1970).

The Apollo 11 lunar samples showed traces of carbon compounds. A discussion is presented on their origin and consideration is given to the following possibilities: are they entrapped solar-wind particles, meteorite or cometary contributions, remnants of a primordial atmosphere, or products of degassing of the Moon? Experimental work included pyrolysis experiments, examination by elevated temperature microscopy, and examination of morphological features by scanning electron microscopy. It is suggested that the lunar carbon compounds may originate from degassing of the Moon, with possibly some contributions from solar wind and perhaps meteorite sources. (UK)

25947 INDIGENOUS LUNAR METHANE AND ETHANE. Abell, P. I. (Univ. of Bristol, Eng.); Eglinton, G.; Maxwell, J. R.; Pillinger, C. T.; Hayes, J. M. Nature (London); 226: 251-2 (18 Apr 1970).

Analysis of Apollo 11 lunar samples showed that CH_4 (up to 6 μg/g) and other gaseous hydrocarbons, ranging from C_2 to C_4, were released on treatment of the fines with aqueous HCl, H_3PO_4, or HF, but it was uncertain whether these hydrocarbons were formed by acid hydrolysis or were present as such in the fines. The present authors showed that CH_4 and C_2H_6 arose from both sources. Details are given of hydrocarbons and deuterated hydrocarbons released by vacuum crushing and by DCl treatment of the fines. Releases of 1 μg/g CH_4 and 0.1 μg/g C_2H_6 were obtained by crushing. Interpretation of the data is that the greater part of the methane and ethane released by crushing or acid treatment arose from reactions brought about during the analysis, and it was likely that hydrolysis of carbides was the main source of these hydrocarbons, as shown by the evolution of CD_4, C_2D_6 and other almost completely deuterated hydrocarbons. Such hydrolysis can evidently take place during the vacuum crushing process, although prolonged contact of the fines with D_2O, without crushing, released no hydrocarbons. What is more significant is that most of the remainder of the methane and ethane was completely unlabelled, showing that this fraction must have been present as such in the fines. The carbide in the lunar sample was probably of meteoritic origin, but the trapped gaseous hydrocarbons might originally have been present in the igneous lunar rocks or could have had one or more of the following origins: (i) hydrolysis of carbides in situ on the Moon, for example from hydroxylic groups formed by solar-wind implantation of protons; (ii) thermal or radiation induced alteration of indigenous organic matter; (iii) by formation from the solar wind, for example by hydrogenation of indigenous or solar-wind carbon by solar-wind implanted hydrogen. The present data do not distinguish between these possibilities. (UK)

25948 OBSERVATIONS OF EMISSION FROM SATURN AT 408 MHz. McAdam, W. B. (Univ. of Sydney). Proc. Astron. Soc. Aust.; 1: 199-201(Mar 1969).

Meridian transit observations were made on 11 nights in Oct. 1968 during opposition. Digital data were superimposed according to the ephemeris position, and on estimate of the flux density for any point source within ±1 min R.A. of this position was obtained by convolving the data with the aerial beam in R.A. and declination. When measurements at all wavelengths were compared, the spectrum showed a rapid increase at long wavelengths. (W.D.M.)

Atomic and Molecular Physics

Refer also to abstract 25324.

25949 ADVANCES IN ATOMIC AND MOLECULAR PHYSICS. VOLUME 5. Bates, D. R.; Estermann, Immanuel (eds.). New York; Academic Press Inc. (1969). 442p. $18.50.

Survey articles on the following subjects are included: flowing afterglow measurements of ion–neutral reactions, experiments with merging beams, rf spectroscopy of stored ions (part II), spectra of molecular solids, the meaning of collision broadening of spectral lines (the classical-oscillator analog, calculation of atomic transition probabilities, table of one- and two-particle coefficients of fractional parentage for configurations $s^{\lambda}s'^{\mu}p^{\theta}$, and relativistic Z-dependent corrections to atomic energy levels. Each article is intended to provide an introduction to the subject, a summary of past work with emphasis on the last five years, and a sufficiently complete bibliography to facilitate location of details in the literature. (A.G.W.)

Atomic, Electron, Ion, and Molecular Beams and Their Reactions

Refer also to abstracts 25335, 25336, and 26557.

25950 AUGER-ELECTRON SPECTROSCOPY OF TRANSITION METALS. Haas, T. W.; Grant, J. T.; Dooley, G. J. (Aerospace Research Labs., Wright-Patterson Air Force Base, Ohio). Phys. Rev., B; 1: 1449-59(15 Feb 1970).

The Auger-electron spectra in the intermediate- and low-energy range (0−1 keV) for many of the transition metals of periods 4−6 (specifically, Sc, Ti, V, Cr, Fe, Co, Y, Zr, Nb, Mo, Ru, Rh, La, Hf, Ta, W, Re, Ir, Pt, and Au) were measured. In general, the spectra from elements in the same period of the Periodic Table are similar, the main difference being the energy at which the Auger electrons appear. The main transitions observed from period-4 elements are of the LMM type. For period-5 elements, the Auger transitions involve MNN levels, and for the period-6 elements, the transitions are of the NNN (Coster−Kronig) type. (auth)

25951 STOPPING POWER OF MATTER FOR DEUTERONS AT EXTREME RELATIVISTIC ENERGIES. Vora, R. B.; Turner, J. E. (Oak Ridge National Lab., Tenn.). Phys. Rev., B; 1: 2011-14(1 Mar 1970).

The stopping power of matter for deuterons at extreme relativistic energies ($\lesssim$2000 GeV) are calculated. The structure of this particle and its spin are taken into account explicitly. It is found that the ultrarelativistic effects reduce the stopping power (as predicted by the relativistic formula) by 8% at the highest energies considered. These effects are analyzed numerically and compared with the estimated density correction. A stopping-power table for deuterons in aluminum is computed. (auth)

25952 ELECTRON MEAN FREE PATH NEAR 2 keV IN ALUMINUM. Kanter, H. (Aerospace Corp., El Segundo, Calif.). Contract FO4701-69-C-0066. Phys. Rev., B; 1: 2357-8(1 Mar 1970).

From beam-attenuation measurements on evaporated films 125−185 Å thick, mean free paths for elastic scattering (37 and 26 Å) and for plasmon production (88 and 70 Å) were determined at 2 and 1.5 keV, respectively. (auth)

25953 NEW FINE STRUCTURE IN ELECTRON-EXCITED AUGER SPECTRA FROM SOLID SURFACES. Pessa, M.; Aksela, S.; Karras, M. (Univ. of Oulu, Finland). Phys. Lett.; 31A: 382-3(6 Apr 1970).

Spectra of electron-excited Auger electrons ranging from 0.5 to 1.5 keV from surfaces of Al, Cu, and Sn were measured with an energy resolution of 0.06% by a cylindrical electrostatic analyzer. (auth)

25954 FORM OF THE ENERGY SPECTRUM OF ION-ELECTRON EMISSION FROM THE SURFACE OF SINGLE-CRYSTAL FILMS. Dolgov, A. S. Sov. Phys.-Solid State (Engl. Transl.); 11: 2274-6(Apr 1970).

Translated from Fiz. Tverd. Tela; 11: 2810-12(Oct 1969).

The characteristics of the electron emission from the surface of single-crystal films on bombardment with fast ions are considered theoretically. The diffusion of the electrons excited when the ions collide with the atoms of the medium is discussed. Allowance is made for the absorption and retardation of the electrons. A method of analysis similar to the "age" method widely used in analyzing the slowing-down of neutrons is employed. The depth and energy distribution functions of the electrons are calculated. It is shown that the emission spectrum on the side of the film opposite to the direction of incidence of the beam is deficient in high-energy electrons. (auth)

25955 GENERATION OF POLARIZED ELECTRONS VIA PENNING COLLISIONS OF IMPURITY ATOMS WITH OPTICALLY ORIENTED METASTABLE HELIUM. Schearer, L. D. (Texas Instruments Inc., Dallas). Phys. Lett.; 31A: 457-8(20 Apr 1970).

Spin-dependent Penning collisions between Ar and optically pumped He metastable atoms have been used to produce a high concentration (10^{10} to 10^{11} cm^{-3}) of spin-polarized free electrons (5%) in a flowing He afterglow. The polarization of the free electrons is detected by monitoring the polarization induced in Na atoms following a spin-exchange collision. (auth)

25956 LYMAN-α FROM PROTONS INCIDENT ON MOLYBDENUM. McCracken, G. M.; Erents, S. K. (Culham Lab., Abingdon, Eng.). Phys. Lett.; 31A: 429-30(20 Apr 1970).

Measurements were made of the Doppler shift of the Lyman-α radiation produced when keV protons strike a molybdenum surface. These results show that the Lyman-α is emitted by the decay of excited atoms backscattered from the target. (auth)

25957 VZAIMODEISTVIE ATOMNYKH CHASTITS S POVERKHNOST'YU TVERDOGO TELA. (Interactions of Atomic Particles With the Surfaces of Solids). Arifov, U. A. Moscow; Izdatel'stvo Nauka (1968). 371p.

Static or galvanometric studies of processes taking place during bombardment of solids by atomic particles are described in the first chapter. Migration of adsorbed particles, energy distribution of secondary electrons and ions, and the maximum energies of secondary ions are considered. The second chapter deals with dynamic (oscillographic) methods of study. Ion bombardment of molten metals, and interactions of slow ions with solids are discussed in the third and fourth chapters. The following three chapters deal with the angular regularities of secondary ion emission, secondary processes during bombardment by inert gas ions, and ion and electron emission during bombardment of films of varying density by positive ions. Interactions of neutral atoms with solid surfaces, sputtering of solids by ion beams, secondary electron−electron emission, and theory of various processes taking place during atomic-particle collisions with metal targets are discussed in the last four chapters. 792 references. (R.V.J.)

25958 INTENSITY FLUCTUATIONS OF LIGHT FROM FAST H ATOMS: ADDENDA ON INITIAL-STATE POPULATIONS AND CASCADES. Sellin, I. A.; Griffin, P. M.; Biggerstaff, J. A. (Oak Ridge National Lab., Tenn.). Phys. Rev., A; 1: 1553-6 (May 1970).

A more intensive analysis of the effects of different assumptions about initial-state populations is added to a previous paper on the coherent excitation of hydrogen fine structure by foils. It is found that the previously postulated alignment of angular momenta perpendicular to the beam direction is a sufficient but not necessary assumption; an alternative assumption is that the broad l-state distribution of the collision products has a maximum for d states and also matches the experimental traces adequately. A method of obtaining initial state populations in a manner that suppresses the corrections required for cascade effects is discussed. The method avoids the errors of extrapolating decay-curve fits. (auth)

25959 SURFACE AND VACUUM PHYSICS INDEX. Volume 4, No. 7, 1969. Bibliography, Author Index, Subject Index in Alphabetical Order, Cumulative Subject Index in Logical Order. Frankfurt am Main, Zentralstelle fuer Atomkernenergie-Dokumentation, 1969. 102p.

This listing includes 179 references. (M.O.W.)

25960 SURFACE AND VACUUM PHYSICS INDEX. Volume 4, No. 8, 1969. Bibliography, Author Index, Subject Index in Alphabetical Order, Cumulative Subject Index in Logical Order. Frankfurt am Main, Zentralstelle fuer Atomkerenergie-Dokumentation, 1969. 119p.

This listing includes 228 references. (M.O.W.)

25961 SURFACE AND VACUUM PHYSICS INDEX. VOLUME 4, NO. 9, 1969. Bibliography, Author Index, Subject Index in Alphabetical Order, Cumulative Subject Index in Logical Order. Frankfurt am Main, Zentralstelle fuer Atomkerenergie-Dokumentation, 1969. 122p.

This listing includes 244 references. (M.O.W.)

25962 SURFACE AND VACUUM PHYSICS INDEX. VOLUME 4, NO. 10, 1969. Bibliography, Author Index, Subject Index in Alphabetical Order, Cumulative Subject Index in Logical Order. Frankfurt am Main; Zentralstelle fuer Atomkerenergie-Dokumentation (1969). 136p.

This listing includes 271 references. (M.O.W.)

25963 SURFACE AND VACUUM PHYSICS INDEX. VOLUME 4, NO. 11, 1969. Bibliography, Author Index, Subject Index in Alphabetical Order, Cumulative Subject Index in Logical Order. Frankfurt am Main; Zentralstelle fuer Atomkernenergie-Dokumentation (1969). 95p.

This listing includes 151 references. (M.O.W.)

25964 SURFACE AND VACUUM PHYSICS INDEX. VOLUME 4, NO. 12, 1969. Bibliography, Author Index, Subject Index in Alphabetical Order, Cumulative Subject Index in Logical Order, Frankfurt am Main; Zentralstelle fuer Atomkernenergie-Dokumentation (1969). 83p.

This listing includes 127 references. (M.O.W.)

25965 SURFACE AND VACUUM PHYSICS INDEX. VOLUME 5, NO. 1, 1970. Bibliography, Author Index, Subject Index in

Alphabetical Order, Cumulative Subject Index in Logical Order. Frankfurt am Main; Zentralstelle fuer Atomkernenergie-Dokumentation (1970). 63p.

This listing includes 226 references. (M.O.W.)

25966 SURFACE AND VACUUM PHYSICS INDEX. VOLUME 5, NO. 2, 1970. Bibliography, Author Index, Subject Index in Alphabetical Order, Cumulative Subject Index in Logical Order. Frankfurt am Main; Zentralstelle fuer Atomkernenergie Dokumentation (1970). 58p.

This listing includes 197 references. (M.O.W.)

25967 ON FORMATION PROCESSES FROM EJECTED ATOMS IN SUPEREXCITED STATES DURING ION BOMBARDMENT OF TRANSITION METALS. Blaise, G.; Slodzian, G. (Paris Univ., Orsay, France). J. Phys. (Paris); 31: 93-107 (Jan 1970). (In French).

An ionization process taking place when solid targets, made of 3d transition elements, are sputtered by an argon ion beam of a few keV is studied. Atoms are ejected in superexcited states which are statistically occupied by conduction electrons, and then Auger radiationless transitions may occur (auto-ionization) and give rise to the production of positive ions. Superexcited states are obtained from the 3d and 4s atomic levels, in a one-electron model. For the occupation of superexcited states to take place, the mean energy level of the excited electrons must lie under the Fermi level of the metal. This condition implies several types of superexcited states involving 2 or 3 electrons. Yet, in any case, the production of a hole on the 3d shell is always needed. As a result, this process leads to an ionic yield proportional to the occupation probability of the superexcited states of each element. This probability varies from 2.5×10^{-3} for copper to 1.3×10^{-2} for titanium. (France)

25968 RF ION SOURCE. Okamoto, Yukio; Tamagawa, Hajime (Nagoya Univ., Japan). Oyo Butsuri; 38: 1114-20 (Dec 1969). (In Japanese).

The construction of an ion source is described and its working principles are discussed. Recent data from literature on the mechanism of the ion beam extraction, beam energy distribution, and beam composition are reported as a systematic survey. (auth) (NSA of Japan)

25969 TIME-OF-FLIGHT TEST OF A SLOTTED DISK VELOCITY SELECTOR. Johnson, Neil B.; Heppner, Richard A.; Pridmore, Brooke M.; Zorn, Jens C. (Univ. of Michigan, Ann Arbor). Rev. Sci. Instrum.; 41: 777-8(May 1970).

A method of testing the calibration and transmission characteristics of a high-resolution velocity selector by time-of-flight analysis of a pulsed beam of metastable atoms, which was at the same time mechanically chopped by the velocity selector, is briefly described. (W.H.K.)

25970 A VERSATILE MOLECULAR BEAM SCATTERING APPARATUS UTILIZING ELECTRON BOMBARDMENT DETECTION. Bickes, R. W. Jr.; Bernstein, R. B. (Univ. of Wisconsin, Madison). Rev. Sci. Instrum.; 41: 759-68(May 1970).

A versatile crossed molecular beam apparatus has been designed, fabricated, and tested. The instrument consists of a large cylindrical stainless steel "scattering chamber," which contains differentially pumped nozzle–skimmer and detector chambers. The crossed beams intersect at the cylinder axis. The detector assembly can be rotated about the scattering center from −43 to +133° with respect to the primary beam direction. The scattered intensity is measured using a modified Weiss electron bombardment ionizer with quadrupole mass filter. Overall detection efficiency of the system for a thermal argon beam is 0.25%. Background discrimination is effected by means of double modulation (synchronous chopping of both crossed beams with beat frequency lock-in detection). The apparatus has been employed in studies of the rainbow scattering of Ar by various gases. (auth)

25971 RANGE AND STOPPING-POWER TABLES FOR HEAVY IONS. Northcliffe, L. C.; Schilling, R. F. (Texas A and M Univ., College Station). Nucl. Data, Sect. A; 7: 233-463(Jan 1970).

The electronic stopping power and range (corrected for nuclear stopping) are tabulated for representative ions of all atomic numbers $1 \leq z \leq 103$ in 24 different material media at 38 energies distributed logarithmically throughout the region $0.0125 \leq E/m \leq 12$ MeV/amu. The media include twelve solid elements (Be, C, Al, Ti, Ni, Ge, Zr, Ag, Eu, Ta, Au, and U), nine gaseous elements (H, He, N, O, Ne, Ar, Kr, Xe, and Rn), and three compounds (polyethylene, Mylar, and water). The tables are based on an investigation of the systematic relationships between observed data, guided by simple theoretical expectations and extrapolated into regions where no measurements have been made. (auth)

25972 SURFACE RAINBOWS: A SIMILITUDE BETWEEN CLASSICAL AND DIFFRACTIVE SCATTERING OF ATOMS FROM CRYSTALLINE SURFACES. McClure, J. Doyle (Boeing Scientific Research Labs., Seattle). J. Chem. Phys.; 52: 2712-18 (1 Mar 1970).

A preliminary account is given of sharp "rays" and related intensity structure revealed by high-resolution classical calculations of atomic scattering from an ordered monolayer. Factors related to use of structural features of the intensity maxima for investigation of atom–surface interaction fields are discussed. (auth)

25973 MEASUREMENT OF THE FREQUENCIES OF ION-NEUTRAL COLLISIONS BY DISPERSION OF PSEUDOSONOROUS ION WAVES. Doucet, H. J.; Gresillon, D.; Virmont, J.; Weil, A. (Ecole Polytechnique, Paris). pp 17-25 of International Conference on Physics of Quiescent Plasmas. Pt. III. Paris; Ecole Polytechnique (1969). (In French).

See CONF-690923(Pt.3).

Two experiments carried out in alkaline plasmas ionized by contact in Q machines are presented. This permits the deduction of cross section values for exchange of Cs^+ ion motion in a cold helium gas and then for charge exchange of the Cs^+ ions in cold cesium. It is concluded that the ion waves are very sensitive to ion–neutral collisions. The study of their scattering permits the ion–neutral collision frequencies to be very easily obtained. These measurements allow one to obtain reasonable orders of magnitude for collision cross sections, as well as precise values requiring a good knowledge of the ion distribution functions. (J.F.P.)

25974 ANGULAR DISTRIBUTION OF EFFLUX FROM AN ATOMIC BEAM NOZZLE. Henderson, Dale B. (Los Alamos Scientific Lab., N. Mex.). pp 103-10 of International Conference on Physics of Quiescent Plasmas. Pt. III. Paris; Ecole Polytechnique (1969).

See CONF-690923(Pt.3).

Proper design of atomic beam nozzles for the injection of neutrals into a Q machine requires a knowledge of the distribution of efflux from a single nozzle. Such knowledge is unavailable from either experiment or a theory in the range of physical dimensions and fluxes used in Q machines. The angular distribution of cesium efflux was measured as a function of the driving pressure (or reservoir temperature) for various nozzles. The apparatus employs a hot filament detector fixed in position relative to a nozzle which rotates about its tip. By chopping the beam with a wheel and using phase sensitive detection, signal currents as low as a few picoamperes may be resolved. This is sufficient, for example, to allow measurement of the efflux from a 0.8-mm diameter by a 5.9-mm-long nozzle from the collisional, through the transition, and into the collisionless regimes. A computer is used to sum the effect of many nozzles arranged into a pattern to spray neutrals onto a Q-machine hot plate. (auth)

Atomic and Molecular Properties

Refer also to abstracts 25845, 25887, and 25903.

25975 (AD-700979) TRANSITION PROBABILITIES OF ARGON II. Final Report, 1967-1969. Tidwell, Eugene D. (Arnold Engineering Development Center, Arnold Air Force Station, Tenn. ARO, Inc., Arnold Air Force Station, Tenn.). Feb 1970. Contract F40600-69-C-0001. 21p. (AEDC-TR-70-18). CFSTI.

With the use of two stable, highly ionized argon plasma sources, over 200 spectral lines have been measured and identified. Of these, 70 or more have been used for transition probabilities after they were found to be single, unperturbed argon ion (Ar II) lines. Each line has been tested for abnormal half-widths; those with widths greater than 20% over normal are not used. Excitation temperatures from 1 to 8 eV (kTe) have been used: (1) photographically with a 1.5-m focal length spectrograph and (2) photoelectrically with a 0.5-m spectrometer. As many as 33 observations were tabulated for the stronger lines. All lines have upper-state energy values between 19 and 24.5 eV and lie between 3500 and 5100 A. The absolute intensity of the 4589-A Ar II line produced a density that agreed well with calculated local LTE conditions at $P = 340\ \mu$ Hg and $kT(e) = 1$ eV. The tables and figures include wavelengths, energy states, estimated uncertainty, statistical weights, transition probabilities, and number of observations. Examples of the Maxwell–Boltzmann distributions are shown. (auth) (USGRDR)

25976 (LA-4240) INTERPLANAR SPACING TABLES FOR Mn $K\alpha_1$ RADIATION. Powers, Josephine E.; Kempter, Charles P. (Los Alamos Scientific Lab., N. Mex.). Aug. 1969. Contract W-7405-eng-36. 62p. Dep. CFSTI.

Tables of interplanar spacings are presented for Mn $K\alpha_1$ radiation for the angles θ from 0 to 89.99° at intervals of 0.01° and for the angles 2θ from 0 to 179.98° at intervals of 0.02°. The applicability of the manganese target in comparison with other x-ray targets for the precise determination of lattice parameters is discussed. (auth)

25977 LEVEL-CROSSING EXPERIMENT ON HELIUM 3^3D AND 4^3D STATES BY ION-IMPACT EXCITATION. Buchhaupt, K. (Univ., Giessen, Ger.). Z. Naturforsch., 24a: 1058-62(July 1969). (In German).

The half width of the Hanle-effect signals of the 3 ^3D and 4 ^3D states of helium was determined as a function of helium pressure. By means of density matrix formalism, the mean g-factor was assessed and the lifetime of the states was calculated for 3 ^3D and 4 ^3D as 22 and 36 nsec, respectively. In addition, cross sections for destruction of alignment by the impact of ground-state helium atoms were derived from the pressure dependency of the lifetimes. From the level-crossing signals, information about the fine structure was obtained. (tr-auth)

25978 DOUBLE RESONANCE EXPERIMENTS IN THE Tm I SPECTRUM. Steudel, A.; Wallenstein, R.; Walther, H. (Technische Univ., Hanover). Phys. Lett.; 31A: 433-4(20 Apr 1970).

Optical double resonance experiments in the Tm I spectrum are described. The results for the g_J values are compared to theoretical values. (auth)

25979 $2p^2\ ^3P$ AND $2p3p\ ^1P$ STATES OF THE HELIUM ISOELECTRONIC SEQUENCE. Drake, G. W. F. (Univ. of Windsor, Ont.); Dalgarno, A. Phys. Rev., A; 1: 1325-9(May 1970).

Accurate eigenvalues and radiative lifetimes are obtained for the bound $2p^2\,^3P$ and $2p3p\,^1P$ states of the helium-like ions He I to Ne IX. A high-order Z-expansion perturbation procedure is used that does not require the explicit solution of perturbation equations. The results are compared with variational calculations. The predicted wavelengths of the $1s2p\,^3P-2p^2\,^3P$ and $1s3p\,^1P-2p3p\,^1P$ transitions in helium are, respectively, 320.31 and 308.97 Å. Lines have been observed in helium at 320.39 and 309.04 Å. (auth)

25980 ELECTRON g FACTORS OF LOW-LYING LEVELS OF Ce I. Childs, W. J.; Goodman, S. (Argonne National Lab., Ill.). Phys. Rev., A; 1: 1290-3(May 1970).

Electron g factors were measured for 33 low-lying states of Ce I with the atomic-beam magnetic-resonance technique. (auth)

25981 UPPER AND LOWER BOUNDS TO LONG-RANGE FORCES BETWEEN TWO HYDROGEN ATOMS. Alexander, Millard H. (Harvard Univ., Cambridge, Mass.). Phys. Rev., A; 1: 1397-1401(May 1970).

Bell's technique for the calculation of long-range dispersion-force coefficients is transformed to yield rigorous upper and lower bounds to these coefficients. The bounds involve in a systematic way the negative oscillator strength sums $S(-k)$ of the two interacting atoms. By a slight modification, the leading relativistic correction to the long-range potential can also be bounded. Application of the method to the interaction between two hydrogen atoms yields extremely tight bounds to all the relevant coefficients. (auth)

25982 STUDY OF RELAXATION PROCESSES OF EXCITED ATOMIC LEVELS OF HELIUM WITH A HIGH-FREQUENCY DISCHARGE. Giroud, M.; Lombardi, M.; Pebay-Peyroula, J. C. (Faculte des Sciences, Grenoble, France). J. Phys. (Paris); 30: 789-94(Oct 1969). (In French).

To study various relaxation mechanisms of excited states in an atomic vapor, the method of alignment by high-frequency capacitive discharge was used. In particular, the transfer of excitation in cascade processes for two out of the five levels studied (3^3P, 4^1D_2, 3^1P_1, 3^3D and 3^1D_2) of helium were seen. (auth)

25983 ABSOLUTE GENERALIZED OSCILLATOR STRENGTH OF $1^1S \rightarrow 2^1P$ TRANSITION IN HELIUM. Lassettre, Edwin N.; Skerbele, Ausma; Dillon, Michael A. (Carnegie-Mellon Univ., Pittsburgh). J. Chem. Phys.; 52: 2797-9(1 Mar 1970).

Previously reported generalized oscillator strengths for the 1^1S-2^1P transition in He at 500 eV were renormalized using elastic cross sections obtained by Bromberg (J. Chem. Phys., 50: 3906(1969)). The limiting oscillator strength is calculated and compared with both experimental and theoretical results of others. Comparison with calculations using the Born approximation shows agreement to within the experimental error. (A.G.W.)

25984 ABSORPTION SPECTRUM OF H_2 IN THE VACUUM-UV REGION. I. RYDBERG STATES AND IONIZATION ENERGIES. Takezawa, Sanzo (Air Force Cambridge Research Labs., Bedford, Mass.). J. Chem. Phys.; 52: 2575-90(1 Mar 1970).

The absorption spectrum of molecular hydrogen was investigated in the 950- to 700-Å region with a 6.65-m normal-incidence spectrograph in the second order with the helium continuum as background. Seventeen Rydberg series are identified. Fourteen belong to $np\pi\ ^1\Pi_u \leftarrow X\ ^1\Sigma_g^+$ transitions and consist of Q(K) lines, which converge to levels v = 0 to 5 of the ground state of H_2^+. The other three series belong to $np\sigma\ ^1\Sigma_u^+ \leftarrow X\ ^1\Sigma_g^+$ transitions and consist of P(1) lines for two of the series, and R(0) lines for the third. The lowest ionization energy of H_2, obtained from the Q(K) line series analysis, is 124 417 ± 2 cm^{-1} less than the previously accepted value by 12 cm^{-1}. The autoionization effects observed by Beutler and Jünger in the (6, 0) band of the D $^1\Pi_u \leftarrow X\ ^1\Sigma_g^+$ system are discussed. (auth)

Positronium, Muonium, and Mesic Atoms and Molecules

25985 SOLID-STATE EFFECTS IN PIONIC ATOMS. Grin, G. A. (Univ. of California, Berkeley); Kunselman, R. Phys. Lett.; 31B: 116-18(2 Feb 1970).

Solid-state or chemical effects on the line intensities of pionic atom x-ray spectra were measured for several compounds and mixtures. A possible explanation of the deviations from the Z law is discussed. (auth)

25986 ELECTRON-PHONON INTERACTION AND POSITRON ANNIHILATION IN METALS. Agodi, A.; Baldo, M.; Pucci, R. (Univ., Catania, Italy. Istituto Nazionale di Fisica Nucleare. Catania, Italy). Lett. Nuovo Cim.; 3: 197-202(12 Feb 1970).

An equation is derived for the detection rate of two photons in the annihilation of an electron-positron pair. The temperature dependence of the angular correlation pattern which is present in single crystals but not in noncrystalline samples, is discussed. An attempt is made to study this temperature effect, using the simplified case of annihilation of a thermalized positron in an isotropic homogeneous system of electrons in the presence of electron-phonon interactions. Calculations are made for Al and Zn, and angular-correlation curves are compared for the free-electron case and the electron-phonon case. The electron-phonon interaction appears to produce an enhancement in the tails of the angular-correlation curves, although this effect is within the experimental error range and hence unobservable. (D.L.C.)

25987 DO POSITRONS REALLY ESCAPE FROM A COLD SINGLE CRYSTAL. Faraci, G.; Foti, G.; Turrisi, E. (Univ., Catania, Italy). Phys. Lett.; 31A: 427-8(20 Apr 1970).

An experiment on a Pb-teflon sample was performed, disproving a recent suggestion about the explanation of the observed temperature effect of positrons annihilating in single crystals. (auth)

Collision Phenomena

Refer also to abstracts 25869, 25908, 26185, and 26641.

25988 (NP-18082) ATOMS AND MOLECULES IN STRONG ELECTROMAGNETIC FIELDS OF OPTICAL FREQUENCY. The Reports on the IX International Conference on the Ionized Gas Phenomena, Bucharest, Romania, August 31-September 6, 1969. Reprint No. 79. (Akademiya Nauk SSR, Moscow. Institut Fiziki). 1969. 53p. (In English and Russian). Dep. CFSTI (U. S. Sales Only).

Separate abstracts were prepared for four Russian papers (texts in Russian and English) that were presented on this subject at the conference. (L.M.T.)

For abstracts of individual papers see: 25989-25992.

25989 (NP-18082, pp 3-20) ROLE OF THE ATOMIC LEVELS IN THE MULTIPHOTON IONIZATION. Delone, G. A.; Delone, N. B.; Donskaya, N. P.; Petrosyan, K. B. (Akademiya Nauk SSR, Moscow. Institut Fiziki). (In English and Russian).

The ionization probability and dependence of the probability on field intensity were experimentally investigated for different atoms in strong electromagnetic fields of optical frequency. The experimental conditions filled the requirement of Gavrila (Phys. Rev. 163: 147(1967)) that the ionization have a power-type dependence on the field strength, $W \sim F^K$. In these works, the power $K = K_0$ was obtained, where K_0 is the number of quanta (an integer) the electron absorbs in the ionization process according to the conservation of energy. Results indicate that the dependence of the ionization probability on the radiation intensity is determined by the value of K_0, when the difference between the discrete electron energies is large and changes insignificantly in the field. (L.M.T.)

25990 (NP-18082, pp 21-9) METHOD OF CALCULATION OF MULTIPHOTON PROCESSES IN ATOMS. Rapoport, L. P.; Zon, B. A.; Manakov, N. L. (Voronezh State Univ. (USSR)). (In English and Russian).

A Green function is introduced for the optical electron thereby obviating one of the basic difficulties in calculations of multiphoton processes by perturbation theory, namely: summing the matrix elements of the electromagnetic interaction upon the complete set of intermediate states of the atom, discrete and continuous. (L.M.T.)

25991 (NP-18082, pp 30-41) STRONG OPTICAL FIELD ACTION ON THE HYDROGEN MOLECULE. Berezhetskaya, N. K.; Voronov, G. S.; Delone, N. B.; Delone, G. A.; Piskova, G. K. ([Akademiya Nauk SSR, Moscow. Institut Fiziki]). (In English and Russian).

Using methods analogous to the well-known experiments on multiphoton ionization of atoms (Voronov et al., Soviet Phys., JETP, 50: 78(1966) and 51: 12(1966)), the various ways of H_2 destruction in strong electromagnetic fields were examined. Results are presented from a mass-spectrometric analysis of the ions, and the absolute probability of ionization and the functional dependence of the probability on the photon flux were determined. (L.M.T.)

25992 (NP-18082, pp 42-53) MULTIPHOTON DISSOCIATION AND IONIZATION OF MOLECULES. Berezhetskaya, N. K.; Voronov, G. S.; Donskaya, N. P. (Akademiya Nauk SSR, [Moscow]. Institut Fiziki). (In English and Russian).

Water, carbon dioxide, and nitrogen molecules under strong neodymium-laser field action were investigated. The multiphoton ionization and dissociation processes take place simultaneously. The charged particles can be produced by the ionization of the neutral particles obtained by the molecule multiphoton dissociation, or as a result of the molecule ionization followed by the dissociation of the molecular ions. Only the multiphoton process for the molecules is discussed here, pointing out that the molecular ion dissociation process is, qualitatively, the same. (L.M.T.)

25993 INELASTIC SCATTERING MODEL. Avenhaus, Rudolf (Kernforschungszentrum, Karlsruhe, Ger.); Koppe, Heinz. Z. Naturforsch., 24a: 1145-50(July 1969). (In German).

By means of the stationary and the nonstationary Schroedinger wave equation, one-dimensional two-channel scattering was treated. Bound conditions of the system were determined as well as the probability of transitions with respect to the scattering body. The case is considered in which the scattering body does not possess an energy eigenstate before the scattering event. (H.B.G.)

25994 EXCITATION OF ATOMIC HYDROGEN IN THE VAINSHTEIN APPROXIMATION. Roy, B. N. (Univ. of Durham, Eng.). Indian J. Phys.; 43: 315-19(Jun 1969).

The post form of the Vainshtein approximation is used to calculate cross sections for the processes $H^+ + H(1s) \rightarrow H^+ + H(2s, 2p)$. It is found that the results agree with those of McCarroll & Salin (1966) who used the prior form of the Vainshtein approximation. (auth)

25995 IONIZATION PHENOMENA IN HIGH-ENERGY ATOMIC COLLISIONS. Russek, A.; Meli, J. (Univ. of Connecticut, Storrs). Physica; 46: 222-43(2 Mar 1970).

The statistical theory of ionization produced by atomic collisions is here improved and extended, in line with the concept that the observed ionization is due to quasi-molecular excitation followed by auto-ionization transitions in each of the colliding atoms after the collision is completed. The assumptions of the statistical theory are recast in the form of assumptions regarding the relative sizes of matrix elements in the quantum theory of transition rates, generalized to treat multiple ionization processes occurring in a single transition. The relation of the statistical theory to the Fano–Lichten model is discussed. In addition to calculating the probabilities that the colliding atoms will be found in each of the possible states of ionization, an expression for the energy spectrum of the ejected electrons is obtained. It is also demonstrated that multiple excitation of the outer shell, as occurs in atom–atom collisions, plays a crucial role in determining the probability that a given state of ionization will result from the de-excitation process. The theory permits the comparison of the matrix elements for multiple ionization from those auto-ionizing states in which the outer shell is highly excited (as arises in atomic collisions) with the matrix elements for multiple ionization from those autoionization states in which the outer shell is unexcited (as arises from photo-ionization of an inner shell). (auth)

25996 ENERGY SPECTRA OF ELECTRONS ARISING FROM HEAVY-PARTICLE COLLISIONS IN THE keV REGION. Bierman, D. J.; van der Weg, W. F.; Snoek, C.; Onderdelinden, D. (FOM-Instituut voor Atoom- en Molecuulfysica, Amsterdam). Physica; 46: 244-50(2 Mar 1970).

The energy spectrum of electrons ejected after an inelastic heavy-particle collision is calculated on the assumption that the inelastic energy is statistically distributed among the outer-shell electrons. Together with the measured differential cross section for the inelastic energy this gives an absolute value of the cross section for the production of electrons with a certain kinetic energy. The results are compared with published data of the electron energy spectrum arising from collisions of 100-keV Ar^+ with Ar. (auth)

25997 THERMAL ENERGY ION–MOLECULE REACTIONS. Ferguson, Eldon E. (Environmental Science Services Administration, Boulder, Colo.). Advan. Electron. Electron Phys.; 24: 1-50(1968).

A brief description of experimental methods with emphasis on the flowing afterglow technique is followed by a review of experimental data on reactions in the following categories: (1) those in which heavy-particle transfer occurs, (2) charge transfer in which only an electron changes reactant partners, (3) associative-detachment reactions of negative ions in which an electron is released, and (4) certain miscellaneous reaction types including three-body reactions. A brief discussion of the application of ion–molecule reaction data to several other fields of physics and chemistry is included. 120 references. (A.G.W.)

25998 ON VARIATIONAL PRINCIPLES IN SCATTERING THEORY USING DISCONTINUOUS TRIAL FUNCTIONS. Rudge, M. R. H. (Queen's Univ., Belfast). J. Phys., B (London); 3: 173-7(Feb 1970).

The usual variational principles employed in scattering calculations are only valid provided that the trial functions used are continuous and have continuous first derivatives. Since it is not the wave function itself that is required but rather the quantities that relate to the calculation of cross sections, it may be desirable to use discontinuous functions, in which case the usual variational principles must be altered. Variational expressions are therefore presented for the scattering amplitudes and for the R matrix, which are valid for e–H scattering using a particular class of discontinuous trial functions. (auth) (UK)

25999 ATTENUATION OF A 2.5-keV PROTON BEAM BY INELASTIC COLLISIONS IN CESIUM VAPOR. Spiess, G.; Valance, A.; Pradel, P. (CEN de Saclay, Gif-sur-Yvette, France). Phys. Lett.; 31A: 434-5(20 Apr 1970).

The mechanism of reaction of a proton beam interacting with cesium vapor is studied by measuring the H^- and H^0 outgoing fluxes. The cross sections σ_{+0}, σ_{+-}, σ_{-0}, and σ_{0-} are given; they are in agreement with previous other experiments. (auth)

26000 COHERENT AND INCOHERENT X-RAY SCATTERING BY BOUND ELECTRONS. I. HELIUM ISOELECTRONIC SEQUENCE. Brown, Robert T. (EG and G, Inc., Las Vegas, Nev.). Phys. Rev., A; 1: 1342-7(May 1970).

Atomic form factors and incoherent scattering functions for the helium isoelectronic sequence through Z = 10 were calculated with correlated ground-state wave functions. The wave functions are 120-term configuration-interaction expansions, which give total ground-state energies differing from the most accurate available values by 0.02% for He I and 0.0007% for Ne IX. Comparison with published accurate calculations for helium indicates that the scattering factors, both coherent and incoherent, for the other members of the isoelectronic sequence, should be correct to at least three, and probably four, significant figures. (auth)

26001 X-RAY PRODUCTION CROSS SECTIONS. Garcia, J. D. (Univ. of Arizona, Tucson). Phys. Rev., A; 1: 1402-3 (May 1970).

Recent high-energy measurements of K-shell x-ray yields produced by proton impact are compared with the binary-encounter–impulse approximation and with previous measurements. The scaling law derived from the binary-encounter model is found to be in good agreement with experiment. (auth)

26002 DISSOCIATION AND IONIZATION OF THE HYDROGEN MOLECULAR ION BY ELECTRON IMPACT. Mathur, K. C.; Tripathi, A. N.; Joshi, S. K. (Univ. of Roorkee, India). Phys. Rev., A; 1: 1404-6(May 1970).

The dissociation and ionization cross sections of the H_2^+ molecular ion due to electron impact are studied using the classical impulse approximation. The effect of the Coulomb field of the molecular ion is explicitly included in the calculation. The results are compared with other theoretical calculations. (auth)

26003 EXCITATION OF O_2^+ FIRST NEGATIVE BANDS BY ELECTRON IMPACT ON O_2. Borst, W. L.; Zipf, E. C. (Univ. of Pittsburgh). Phys. Rev., A; 1: 1410-15(May 1970).

Absolute cross sections for the electron-impact excitation of the O_2^+ first negative bands were measured from threshold to 400 eV and extrapolated to 1000 eV by means of a Bethe–Oppenheimer relationship. The peak cross sections for the (n + 1,n) and (n + 2,n) sequences were found to be 5.30×10^{-18}

cm^2 ± 10% and 2.10 × 10^{-18} cm^2 ± 10% at 100 eV, respectively. The cross sections for the (0,0) and (1,0) bands had a maximum value of 2.14 × 10^{-18} cm^2 ± 15% and 4.33 × 10^{-18} cm^2 ± 15%, respectively. The ratio of the total ionization cross section of O_2 to the excitation cross sections of the first negative bands was nearly constant over the energy range 30 to 1000 eV; it had an average value of 64 for the (1,0) band. The lifetime of the $\nu' = 1$ level of the $b^4\Sigma_g^-$ state was found to be 1.19 μsec ± 5%. (auth)

26004 ANGULAR DISTRIBUTION OF PROTONS FROM COLLISIONAL DISSOCIATION OF H_2^+. II. VIBRATIONAL DISSOCIATION. Green, Thomas A. (Sandia Labs., Albuquerque, N. Mex.). Phys. Rev., A; 1: 1416-23(May 1970).

A classical-impulse binary-collision model is used to predict the laboratory angle and velocity distributions of protons resulting from the vibrational dissociation of H_2^+ by He. The treatment is partly heuristic and is not a quantitative success, since the computed cross sections turn out to be roughly an order of magnitude too large compared to those for electronic excitation of the $2p\sigma_u$ state of H_2^+. Nonetheless, the theory clearly identifies some major features of the experimental results of Gibson, Los, and Schopman as being due to vibrational dissociation. (auth)

26005 ELECTRON CAPTURE INTO THE n = 3 STATES OF H BY FAST H^+ IMPACT ON GASES. Hughes, R. H.; Stigers, C. A.; Doughty, B. M.; Stokes, E. D. (Univ. of Arkansas, Fayetteville). Phys. Rev., A; 1: 1424-32(May 1970).

Absolute cross sections for electron capture into the 3p and 3d states of hydrogen were measured for 10- to 100-keV proton impact on He, Ne, Ar, H_2, N_2, and O_2. Improved 3s cross sections are presented for these gases from 10 to 120 keV. An apparent maximum in the 3p cross section occurs in this energy range for all gases. The 3d cross sections decrease monotonically with increasing impact energy according to an $\exp[-(E/K)^{1/2}]$ relationship, where E is the impact energy and K is a constant, with the exception of helium, which shows a maximum in the 3d cross section between 15 and 20 keV. The value of K is identical for all the diatomic gases. Balmer–α cross sections are synthesized from these results. Polarization of the 3d → 2p radiation is reported. (auth)

26006 ANALYSIS OF RECOIL He^+ AND He^{2+} IONS PRODUCED BY FAST PROTONS IN HELIUM GAS. Puckett, L. J.; Martin, D. W. (Georgia Inst. of Tech., Atlanta). Phys. Rev., A; 1: 1432-9(May 1970).

The cross sections for formation of He^+ and He^{++} ions were measured over the energy range from 0.15 to 1.00 MeV for the case of protons incident on helium gas. The individual ions were detected with an electron multiplier operated at near 100% efficiency. An observation of the angular distribution of the slow ions in a "field-free" environment yielded essentially an isotropic distribution in the laboratory reference frame. It was also observed that much less than 1% of the ions had energies greater than 1 eV. It was concluded that, in order for the recoil ions to have an appreciable angular distribution, there must be a substantial energy transfer in the collision, such as would be the case for heavy projectile–target combinations. (auth)

26007 FAST-ELECTRON–ION COINCIDENCE MEASUREMENTS OF THE ARGON ATOM–ION COLLISION. Thomson, G. M.; Laudieri, P. C.; Everhart, E. (Univ. of Connecticut, Storrs). Phys. Rev., A; 1: 1439-44(May 1970).

The triple-valued structure in the inelastic energy loss in certain violent Ar^+-on-Ar collisions is commonly thought to be due to the creation of L-shell vacancies. These should de-excite through an Auger process that results in the emission of fast electrons whose energy is of the order of 180 eV. The present experiment detects such electrons in coincidence with a scattered ion appearing at a known angle θ with a known final charge state m. Large-angle scattering in the reaction $Ar^+ + Ar \rightarrow Ar^{+m} + Ar^{+n} + (m + n - 1)e^-$ is studied for incident energies between 10 and 30 keV, where the Ar^{+m} is scattered to $\theta = 21°$. The electron-energy spectrum measured in coincidence shows the expected peak, though its location in energy decreases as m increases. The number of fast electrons agrees fairly well with the number expected according to a statistical model developed earlier. (auth)

26008 RESONANT PHOTON–HYDROGEN-ATOM SCATTERING. Miller, Arthur I. (Lowell Technological Inst., Mass.). Phys. Rev., A; 1: 1552-3(May 1970).

A method of calculating elastic photon–hydrogen scattering at resonance fluorescence, where the result of Gavrila is invalid, is presented. The effects of the unitarity-violating direct nonresonant and crossed terms are also calculated and shown to be small, as expected. (auth)

26009 ELECTRON SHAKE-OFF IN NEON AND ARGON AS A FUNCTION OF ENERGY OF THE IMPACT ELECTRON. Carlson, Thomas A.; Moddeman, W. E.; Krause, Manfred O. (Oak Ridge National Lab., Tenn.). Phys. Rev., A; 1: 1406-10(May 1970).

Abundances of satellite lines relative to diagram lines in the K-auger spectrum of neon and L-Auger spectrum of argon are measured as a function of the energy of impact electrons. The ratios of satellite to diagram lines are found to be independent of the energy except near the threshold for initial ionization, where the ratios decrease sharply. These ratios are taken to be evidence of the extent of initial double-to-single ionization, i.e., the KL to K ionization in neon and LM-to-L ionization in argon; and the results are discussed in terms of electron shake-off and the sudden approximation. (auth)

26010 TREATMENT OF CORRELATIONS IN THE THEORY OF ELECTRON-IMPACT BROADENING. Burgess, D. D. (Imperial Coll. of Science and Tech., London). J. Quant. Spectrosc. Radiative Transfer; 10: 365-71(May 1970).

Quantum statistical techniques were used to determine the best way to approximate the effects of correlations amongst the perturbers in calculations of electron-impact broadening. It was shown that, in this context, the shielding of the interaction could not be described by the static Debye potential, since the physical similarity between the electron-impact broadening process and Landau damping requires that the latter should always be included in the calculation. The effects of correlations not included in the random phase approximation were discussed briefly. (auth) (UK)

26011 APPROXIMATE TREATMENT OF SHAPE RESONANCES IN ELASTIC SCATTERING. Dickinson, A. S. (Queen's Univ., Belfast). Mol. Phys.; 18: 441-9(1970).

New connection formulae for barrier penetration problems are derived based on the analytic solution of an inverted Morse potential. These are employed to determine approximate phase shifts for atom–atom collisions and in particular the positions and widths of the quasibound states of the effective potential controlling the collisions. Good agreement with the results derived using connection formulae based on a parabolic barrier is obtained. A complex angular momentum treatment of the resonances due to these quasi-bound states is discussed. Some comparisons with exact calculations are presented and a first-order treatment is shown to be very accurate. (auth) (UK)

26012 ELECTRON IMPACT EXCITATION OF POSITIVE IONS. Burgess, A. (Cambridge Univ., Eng.); Hummer, D. G.; Tully, J. A. Phil. Trans. Roy. Soc. London, Ser. A; 266: 225-79(Apr 1970).

Nonrelativistic Coulomb–Born–Oppenheimer reactance matrices and cross sections are given for all transitions between the 1s, 2s, and 2p states in He^+ and in hydrogen-like ions of large nuclear charge. From these results some cross sections for intercombination transitions in highly charged nonhydrogenic ions are estimated. (auth) (UK)

26013 X-RAY SPECTRA FROM ARGON–ARGON COLLISIONS. Cunningham, M. E. (Univ. of California, Livermore); Der, R. C.; Fortner, R. J.; Kavanagh, T. M.; Khan, J. M.; Layne, C. B.; Zaharis, E. J.; Garcia, J. D. Phys. Rev. Lett.; 24: 931-3(27 Apr 1970).

Spectral measurements have been made of L-shell x rays produced by 50- to 330-keV Ar ions incident on Ar gas targets. The data are considered within the framework of the level-crossing model of Fano and Lichten, and the observed lines are consistent with Hartree–Slater calculations for highly excited configurations. (auth)

26014 DYNAMICS OF THE REACTION OF Ar^+ WITH D_2. Chiang, M.; Gislason, E. A.; Mahan, B. H.; Tsao, C. W.; Werner, A. S. (Univ. of California, Berkeley). J. Chem. Phys.; 52: 2698-2708(1 Mar 1970).

Measurements of the velocity vector distributions of the ionic products of collisions of Ar^+ with D_2 and He for relative energies between 2.26 and 9.1 eV are reported. The ion ArD^+ is produced by a direct interaction mechanism, which gives considerable forward scattering. The nonreactive scattering of Ar^+ by D_2 is intense, nearly elastic, and very similar to the scattering of Ar^+ by He. Differential reactive cross sections are determined, partially deconvoluted, and compared with results from several other laboratories. (auth)

26015 EXPERIMENTAL STUDY OF THE DEACTIVATION OF EXCITED H ATOMS BY ATMOSPHERIC GASES. Shukla, R. V.; Jain, S. K.; Gupta, S. K.; Srivastava, A. N. (Univ. of Allahabad, India). J. Chem. Phys.; 52: 2744-6(1 Mar 1970).

H_α and several other members of the Balmer series of the H atom have been observed in the afterglow of water vapor. The intensity variation of the H_α line with the pressure of H_2O, O_2, and

N_2 gases has been studied photometrically. The quenching coefficients of H_α line for these gases have been found to be 1.80 × 10^{-8}, 3.32 × 10^{-8}, and 1.98 × 10^{-8} cm^3 $molecule^{-1}$ sec^{-1}, respectively. (auth)

26016 THEORY OF ATOM–DIATOM COLLISIONS. III. AN INTEGRAL EQUATION FORMALISM FOR LEVEL WIDTHS AND SHIFTS. Sams, W. Neal; Kouri, Donald J. (Univ. of Houston, Tex.). J. Chem. Phys.; 52: 2556-66(1 Mar 1970).

An integral equation formalism for calculating level widths and shifts for Feshbach-type compound state resonances is presented. As in previous studies, the resonances are initially defined by means of the distortion approximation eigenstates of the closed-channel projected Hamiltonian. The level shift then contains corrections to the real part of the resonance energy arising from coupling of the distortion state to other closed channels as well as to the open channels. The level width contains effects due to both open and closed channels and far resonances. Because the Feshbach formalism is employed, the level width and shift are dependent on the scattering energy, in contrast to the Breit–Wigner parametrization of the resonances. The method of Sams and Kouri for obtaining noniterative solutions to integral equations is proposed as a practical method for obtaining accurate level widths and shifts beginning with the distortion approximation to the resonances. It results, in this method, that the solution of the integral equation for the level width and shift is very similar to that for the nonresonant scattering integral equation. (auth)

26017 STUDY OF THE GLORY EFFECT FOR ATOMIC COLLISIONS IN THE HYPERTHERMAL ENERGY REGION. Neumann, W. (Univ., Bonn); Pauly, H. J. Chem. Phys.; 52: 2548-55(1 Mar 1970).

The velocity dependence of the total collision cross section for the systems Li–Hg, Na–Hg, K–Hg, Rb–Hg, Cs–Hg, and Na–Cs was measured for energies between several electron volts and several hundred electron volts. Because of the high angular resolution of the apparatus it was possible to resolve in all cases the glory undulations, which are analyzed in order to determine potential parameters. The influence of the finite angular resolution of the apparatus on the observed glory structure is discussed. (auth)

26018 QUANTUM-MECHANICAL SOLUTION OF THE COLLINEAR ATOM–DIATOMIC COLLISION WITH A LINEAR INTERACTION POTENTIAL. Diestler, D. J. (Purdue Univ., Lafayette, Ind.). J. Chem. Phys.; 52: 2280-5(1 Mar 1970).

The method of Shuler and Zwanzig is extended to treat the collinear collision of an atom interacting with a diatomic molecule by a linear finite-slope repulsive potential having an adjustable attractive step. The interaction potential has two parameters, one governing the strength of the repulsive portion and the other the strength of the attractive portion. Results for the system in which all particles have equal mass are presented for five different combinations of the potential parameters. In two of the cases the potential is strictly repulsive and in the other three it has an attractive well in addition to the linear repulsive wall. The presence of the attractive well causes resonances in the probability curves at certain energies corresponding to the formation of metastable "complexes." (auth)

26019 PRODUCTION OF n = 3 AND n = 4 STATES OF ATOMIC HYDROGEN BY ELECTRON IMPACT ON H_2. Weaver, L. D.; Hughes, R. H. (Univ. of Arkansas, Fayetteville). J. Chem. Phys.; 52: 2299-2301(1 Mar 1970).

Absolute cross sections for the production of H_α ($n = 3 \rightarrow 2$) and H_β ($n = 4 \rightarrow 2$) emissions by electron impact on H_2 were measured in the energy ranges 20 to 400 eV and 30 to 400 eV, respectively. Time-resolved spectra were taken for 50-, 75-, and 110-eV impact in which the s-state decays could be definitely identified since the decay times agreed with theory. All decays could be fit with a two-mode decay scheme, the second mode having a lifetime somewhat longer than the d-state theoretical lifetime. The possibility of Stark mixing of certain states is discussed. Cross sections for the production of atoms in the 3s and 4s states are estimated for 50, 75, and 110 eV. The $3s \rightarrow 2p$ contribution to H_α and the $4s \rightarrow 2p$ contribution to H_β are about 24% and 14%, respectively, at these energies. (auth)

26020 ABSORPTIVE PART OF CHARGE POLARIZATION CORRECTIONS FOR ELECTRON SCATTERING IN THE KILO-ELECTRON VOLT ENERGY RANGE. Bonham, R. A. (Indiana Univ., Bloomington). J. Chem. Phys.; 52: 2387-91(1 Mar 1970).

The calculation of the effect of the absorptive part of charge polarization on elastic electron scattering is investigated in the second Born approximation using closure in an approximate manner. Errors in a previous study are corrected, and the angular dependence of the polarization correction is found to be strongly peaked in the forward direction with a long tail at large s values, which makes a significant contribution to the scattering. The effects of the polarization correction on the scattered intensity and on the phase of the scattered amplitude are discussed in view of experimental observations. Results for the case of elastic electron scattering from Xe are found to be in good agreement with experiment. Corrections to the diffraction measurement of chemical binding energies of molecules containing first-row elements appear to be negligible. (auth)

26021 H–H* INTERACTIONS: THE ADIABATIC POLARIZATION OF H BY H*. Ritchie, A. B. (Harvard Univ., Cambridge, Mass.). J. Chem. Phys.; 52: 2451-5(1 Mar 1970).

The method of polarized orbitals of Temkin used for slow electron–atom scattering is extended to interactions of the type (H, H*) and (H, p^+, e^-), where the excited electron is of high principal quantum number if bound or low k if in the continuum. The equation of motion for the excited electron is derived, and the solution written as a partial wave expansion. All direct potentials are calculated, and applications are discussed. (auth)

Atomic Theory

26022 TRANSFERABILITY OF ATOMIC HARTREE–FOCK VALENCE-SHELL ORBITALS AND CHEMICAL PERIODICITY. Adams, William H. (Rutgers–The State Univ., New Brunswick, N. J.). J. Amer. Chem. Soc.; 92: 2198-2210(22 Apr 1970).

The atomic valence-shell Hartree–Fock orbitals of atoms in the same column of the periodic table are shown to be of at least the same size and, in a number of cases, to be nearly identical. This is done by comparing graphs of the Hartree–Fock orbitals and by calculating various energy integrals with them. The calculations have been carried out for all elements in the first four periods of the periodic table except the transition elements and for their singly charged negative ions. Before the comparisons are made, the valence orbitals of an atom are orthogonalized to the core orbitals of the atom lying below it in the periodic table, with whose valence orbitals the comparison is to be made. This causes the valence orbitals of the first atom to take on the same nodal structure as those of the second. It is shown that the valence orbitals of two atoms when compared in this way will be nearly identical if their ionization potentials are nearly equal, or if their Hartree–Fock valence-orbital energies are nearly equal. (auth)

26023 AUTOIONIZATION LEVELS OF ATOMS AND IONS HAVING FROM THREE TO FIVE ELECTRONS. Safronova, U. I.; Kharitonova, V. N. Opt. Spectrosc. (USSR)(Engl. Transl.); 27: 300-2(Oct 1969).

Translated from Opt. Spektrosk.; 27: 550-5(Oct 1969).

The first two orders of the perturbation theory series for the energies of auto-ionization states of three-, four-, and five-electron systems were calculated. The results of the calculation are compared with available experimental results for He^-. (auth)

26024 FIELD-CORRELATION EFFECTS IN MULTIPHOTON ABSORPTION PROCESSES. Agarwal, G. S. (Univ. of Rochester, N. Y.). Phys. Rev., A; 1: 1445-59(May 1970).

The dependence of the multiphoton absorption probability for an atomic system on the statistical properties of the incident light is investigated. It is shown, by means of nth-order time-dependent perturbation theory, that the multiphoton absorption probability depends on the (n,n)th normally ordered correlation functions of the electromagnetic field. For stationary fields, the transition probability per unit time is constant and is directly related to the reduced cross-spectral correlation function of the electromagnetic field. This expression for the transition probability is then analyzed under various conditions of coherence. Explicit calculations are carried out for thermal light and for laser light, and the transition rates are compared when each has a Lorentzian spectrum. In particular, when the width of the final atomic level is much larger than the bandwidth of the field, the transition rate for thermal light is n! times higher than with laser light of the same mean intensity. The other extreme case, i.e., when the width of the final atomic level is much smaller than the bandwidth of the field, is also considered in detail. An equation for the density operator of the field is derived; this equation governs the change in the statistical properties of the photon system in n-photon absorption processes. On the basis of this equation, the time-dependent properties of the photon system are then studied and some physical consequences of these equations are discussed. Some numerical solutions relating to the time dependence of the factorial moments in two-photon absorption processes are presented. (auth)

26025 VIRTUAL ORBITALS IN HARTREE–FOCK THEORY. Huzinaga, Sigeru; Arnau, Catalina (Univ. of Alberta, Edmonton). Phys. Rev., A; 1: 1285-8(May 1970).

An arbitrariness of virtual orbitals in the Hartree–Fock theory is discussed, and it is explicitly demonstrated that the energy spectrum of the virtual orbitals can be manipulated so that the convergence property may be improved in the perturbation theory and the configuration interaction calculation based on the Hartree–Fock equation. (auth)

26026 RELATIVISTIC SELF-CONSISTENT-FIELD THEORY FOR OPEN-SHELL ATOMS. I. Leclercq, J. M. (Ecole Polytechnique, Paris). Phys. Rev., A; 1: 1358-68(May 1970).

The formulation of a relativistic restricted multiconfigurational self-consistent-field theory for open-shell atoms is given. The relativistic Hamiltonian is the sum of the one-electron Dirac–Hamiltonian and the two-electron Coulomb-repulsion terms. The total wave function is assumed to consist of a linear combination of eigenfunctions of total operators J^2 and J_z, which are themselves assumed to be known linear combinations of Slater determinants of four-component one-electron orbitals. The applicability of the formulation derived in this first paper is limited to wave functions expanded in terms of a set of distinct Slater determinants D_i, which obey the three conditions: (1) Two or more "core shells" may belong to a same symmetry species k but their occupations must be similar. (2) Distinct "peel shells" must belong to different symmetry species k. (3) The symmetry species of the peel shells must be different from the symmetry species of the core shells. The most important cases are the calculations using wave functions expanded in terms of the distinct Slater determinants that arise from the $(2\bar{p})^n(2p)$, $(3\bar{d})^n(3d)^{n'}$, and $(4\bar{f})^n(4f)^{n'}$ configurations. (auth)

26027 ASYMPTOTIC PROPERTIES OF ATOMIC FORM FACTORS AND INCOHERENT SCATTERING FUNCTIONS. Goscinski, O.; Lindner, P. (Uppsala Univ.). J. Chem. Phys.; 52: 2539-40(1 Mar 1970).

By use of the cusp condition for electronic wave functions the exact asymptotic behavior of the atomic form factor is determined. The relation between the pair distribution function and the incoherent scattering function for large wave vector is pointed out. (auth)

26028 ATOMIC AND MOLECULAR PSEUDOPOTENTIAL STUDIES USING GAUSSIAN ORBITALS. Simons, Gary; Mazziotti, Alexander (Johns Hopkins Univ., Baltimore). J. Chem. Phys.; 52: 2449-55(1 Mar 1970).

The Hellmann model potential is employed for the first time in atomic and molecular calculations with a Gaussian basis set. The use of Gaussian functions allows for the simple application of the pseudopotential method to large molecular systems while maintaining the accuracy exhibited by Slater-type-orbital calculations. A new model potential specifically designed for Gaussians, $V(r) = C_1r^2 + C_2$, is proposed and used to examine a series of two-valence-electron atoms. A number of diatomic molecules are studied with both the Hellmann and Gaussian model potentials. Bond lengths, vibrational frequencies, dipole moments, and dissociation energies are calculated, and the results are generally in good accord with experimental data. The Phillips–Kleinmann pseudopotential formalism is used to examine the model potentials and analyze the atomic and molecular results. (auth)

Cosmic Radiation

Refer also to abstracts 25276, 26355, and 26364.

26029 (INSJ-114) HORIZONTAL AIR SHOWER AND ANOMALOUS MUON INTERACTION. Mizutani, Kohei; Mori, Kenju (Tokyo Univ. (Japan). Inst. for Nuclear Study). 9 Feb 1970. 5p. Dep. CFSTI (U. S. Sales Only).

Recently, the nature of primaries of horizontal air showers was discussed with regard to the massive SU(3) triplet by Sitte (1969). It is pointed out that there exists another possibility for explaining this phenomenon from the perspective of the supposed anomalous muon interaction as well as from consideration of general aspects of cosmic-ray phenomena. (W.D.M.)

26030 SEMI-DIURNAL ANISOTROPY OF COSMIC RADIATION IN THE ENERGY RANGE 1 TO 200 GeV. Rao, U. R.; Agrawal, S. P. (Physical Research Lab., Navrangpura, India). J. Geophys. Res.; 75: 2391-2401(1 May 1970).

From an analysis of the data from the worldwide network of neutron monitor stations, the general characteristics of the yearly mean semidiurnal component of cosmic radiation are derived. The mean semidiurnal component in the energy range 1 to 200 GeV can be represented as $[\Delta J(R)/J(R)] = 4 \times 10^{-5} R \cos^2 \Lambda$, for $R < 200$ GV, and $[\Delta J(R)/J(R)] = 0$, for $R > 200$ GV. The semidiurnal component has a maximum along a direction perpendicular to the direction of the mean interplanetary field vector, varies as the first power of rigidity, and varies as $\cos^2 \Lambda$ where Λ is declination. The phase and the amplitudes of the semidiurnal component also seem to be practically invariant with time during the period 1958–1968. The mean properties of the semidiurnal anisotropy are consistent with the hypothesis of a positive density gradient of cosmic-ray intensity in a direction perpendicular to the plane of ecliptic. (auth)

26031 SIDEREAL-TIME VARIATIONS IN THE COSMIC-RAY INTENSITY. Briggs, R. M.; Hicks, R. B.; Standil, S. (Univ. of Manitoba, Winnipeg). Nuovo Cim.; 66B: 97-104 (11 Mar 1970).

Experimental results obtained between May 19, 1967 and May 17, 1968 for inclined muon telescopes, responding to primaries of energy above about 20 GeV and scanning the equatorial plane, are presented. The asymptotic arrival directions for these telescopes have a narrow spread in terms of asymptotic longitude and these telescopes are therefore well suited for sidereal anisotropy studies. The sidereal analyses described yield marginal evidence for a sidereal anisotropy of amplitude $\lesssim 0.05\%$. (auth)

Direct Energy Conversion

26032 (AD-698821) INVESTIGATION OF THE NEUTRALIZATION PLASMA IN THERMIONIC CONVERTERS. Final Report, October 1, 1966–October 31, 1969. Andersen, Rodney J.; Nighan, William L.; Bullis, Robert H. (United Aircraft Corp., East Hartford, Conn. Research Labs.). 31 Oct 1969. Contract F19628-67-C-0069. 71p. (UARL-H-920499-13; AFCRL-69-471). CFSTI.

An investigation was directed toward obtaining an improved understanding of the properties of the cesium neutralization plasma existing in ignited-mode thermionic converters. Toward this end an analysis was made of electron and ion transport phenomena based on conditions known to exist in thermionic-converter plasmas. In support of this analysis, detailed measurements of electron density and temperature in the ignited-mode converter plasma were made using high-resolution spectroscopic techniques. With this information, quantitative estimates were made of: the electric field intensity, the electron kinetic energy flux, the ion current density, and the charged-particle production rate. On the basis of these results, an interpretation was made of the role played by the cesium neutralization plasma in determining converter performance. (auth) (USGRDR)

26033 (NASA-SP-5057) SELECTED TECHNOLOGY FOR THE ELECTRIC POWER INDUSTRY. The Proceedings of a Technology Utilization Conference held at Lewis Research Center, Cleveland, Ohio, September 11–12, 1968. (National Aeronautics and Space Administration, Washington, D. C. Scientific and Technical Information Div.). 1968. 328p. (CONF-680974). CFSTI.

Twelve papers were presented, of which separate abstracts were prepared for four. One paper, by Samuel J. Kaufman et. al, on Nuclear Reactor Heat Sources for Future Power Generation was previously abstracted as NSA 24: 13535. (L.M.T.)

For abstracts of individual papers see: 25199, 25634, 26034, and 26095.

26034 (NASA-SP-5057, pp 281-303) DIRECT ENERGY CONVERSION. Schwartz, Harvey J.; Ward, James J.

NASA-sponsored activities in the following types of direct-conversion processes are reviewed: (1) electrochemistry, (2) thermoelectrics, (3) thermionics, and (4) magnetohydrodynamics. For illustrative purposes, 5 tables, 6 figures, and 7 pictures are included. Of the methods discussed, it is concluded that only the battery may possibly have influence on the electrical industry in the relatively near future; it is pointed out, however, that the other areas should be reassessed as technology improves in them. (L.M.T.)

26035 QUASI-ONE-DIMENSIONAL ANALYSIS OF FLOW IN MHD-GENERATOR CHANNELS. Bityurin, V. A.; Lyubimov, G. A. (Inst. of High Temperatures, Moscow. Moscow State Univ.). Teplofiz. Vys. Temp.; 7: 974-86(Sep-Oct 1969). (In Russian).

A series of differential equations were obtained for describing in (hydraulic) approximation the flow in an MHD-generator channel, taking into account spatial effects related to the inhomogeneity of the flux and nonideal channel insulation. (R.V.J.)

26036 NONSTEADY FLOW IN A MAGNETOHYDRODYNAMIC SHOCK-WAVE GENERATOR OF FINITE LENGTH. Stingelin, Valentin (Institut Battelle, Geneva). Z. Angew. Math. Phys.; 21: 47-60(25 Jan 1970).

The passage of a single shock wave of moderate Mach number across a Faraday-type MHD-generator with segmented electrodes and a constant cross section is investigated theoretically. Wall friction is neglected, the magnetic field and the electric conductivity are assumed constant, and there is no Hall current. This essentially uniform, one-dimensional flow is adequately described by the momentum equation, the continuity equation, and the energy equation. Through the transformation of this system of partial differential equations onto the local directions of the characteristics and the path line respectively, a system of ordinary differential equations, the so-called compatibility equations, are obtained. (M.H.R.)

26037 DEVICE FOR RUPTURE CONTROL OF ASSOCIATED MEMBRANES OF A SHOCK TUBE FOR A MAGNETOHYDRODYNAMIC GENERATOR. Bouvet, Jean (Institut Battelle, Geneva). Z. Angew. Math. Phys.; 21: 61-5(25 Jan 1970). (In French).

In the experimental device, the MHD generator receives the current from a gas in the shock tube. This gas, argon, heated beforehand to 1200°C and seeded with alkaline metal (potassium), is brought to the pseudoplasma state under the influence of a shock wave. This wave is obtained by means of a membrane and a driving gas (helium). The use of a pulsed magnetic field at the level of the MHD generator makes a time delay necessary between the beginning of the discharge of the condensers, the source of energy which has to create the pulsed magnetic field, and the rupture of the membrane producing the shock wave (the rise time of the magnetic field is longer than the traveling time of the shock wave from the membrane to the entrance of the generator). A projectile shot along the axis of the tube and behind the membrane, which is suitably scratched and near rupture under the influence of the helium pressure, will ensure its rupture without disturbing the flow in the tube. The passage of this projectile is detected behind the membrane by a photoelectric cell. The signal obtained triggers the discharge of the condensers in such a way that the arrival of the shock wave in the generator coincides with the beginning of the peak of the magnetic field. The projectile is propelled by a compressed gas pistol operating under variable pressure, which makes it possible to adjust the time delay to within ±0.2 msec. (auth)

26038 THERMOELECTRIC GENERATORS USING RADIOISOTOPES. Heys, H. Electron. Equip. News; 12-16(Mar 1970).

A description is given of the UK "Ripple" series of low-power radioisotopic thermoelectric generators, designed for terrestrial use in remote situations. The prototype series range in power up to 4 W. Details are given of the radioisotopic heat source (^{90}Sr as $SrTiO_3$), the means of conversion of heat to electrical power, the containment, insulation and shielding, applications, the economic range, and size and weight. (UK)

Fluid Physics

Refer also to abstract 26035.

26039 A NEW MOMENTUM INTEGRAL METHOD FOR MHD CHANNEL ENTRANCE FLOWS. Schwirian, R. E. (Lewis Research Center, Cleveland). AIAA (Amer. Inst. Aeronaut. Astronaut.) J.; 8: 565-7(Mar 1970).

A momentum integral technique was developed which uses a boundary-layer "edge" shear stress to derive core flow and boundary-layer equations of motion for MHD entrance flows. The edge stress acts as a viscous coupling boundary layer and the core flow and allows the latter to develop a viscous pressure drop, which standard momentum integral techniques do not permit. Basically, the governing equations are integral forms of Prandtl's boundary-layer equations with a shear stress acting between the boundary-layer and core flow. (M.H.R.)

26040 AN EQUILIBRIUM AND A STABILITY OF TOROIDAL PLASMA WITH A SMALL ASPECT RATIO. Oshiyama, Hiroshi (Kyoto Univ.). Kakuyugo Kenkyu; 24: 293-303(Feb 1970). (In Japanese).

Toroidal equilibrium and stability of MHD plasma with a small aspect ratio are examined analytically under the assumption that the distribution of plasma pressure is linear or quadratic in stream function. The existence of a stable equilibrium configuration is shown by using the energy principle. (auth)

26041 GENERATION OF A LARGE SCALE MAGNETIC FIELD BY A TURBULENT LIQUID. Vainshtein, S. I. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Zh. Eksp. Teor. Fiz.; 58: 153-9(Jan 1970). (In Russian).

A magnetic field equation is derived for the case of (1) gyrotropic turbulence and 2) anisotropic turbulence. The method of sample summation of the perturbation theory series is employed. Exact solutions of the problems are obtained for a certain turbulence model. The most important assumption which is made is that the correlation time of the velocities can be neglected. In the first case, it follows from the equation that gyrotropic turbulence may produce a large-scale magnetic field. Conditions for generation of the field are determined. Anisotropic turbulence does not generate a large-scale field and, on the contrary, it results in anomalous anisotropic diffusion of the field. Isotropic turbulence also leads to anomalous field diffusion. (auth)

26042 HYDROMAGNETIC OSCILLATIONS OF AN INCOMPRESSIBLE VISCOUS HOMOGENEOUS CYLINDER. Srivastava, K. M.; Kushwaha, R. S. (Univ. of Jodhpur, India). Proc. Nat. Inst. Sci. India, Part A, Suppl.; 35: No. 2, 195-209(Jul 1969).

The joint effect of a uniform axial magnetic field and the dissipative viscous forces on the gravitational instability of a cylinder for axisymmetric perturbations was studied. It was assumed that the fluid cylinder is homogeneous and incompressible. In particular, the case of high viscosity is derived. It is established that no magnetic field, however strong, can stabilize the cylinder for deformations of all wavelengths. (auth)

26043 REFLECTION OF MAGNETO-ACOUSTIC WAVES FROM AN ELASTIC LAYER WITH A FINITE ELECTRIC CONDUCTIVITY. Kosachevskii, L. Ya.; Ponomarenko, V. G. Zh. Prikl. Mekh. Tekh. Fiz.; No. 5, 129-33(Sep-Oct 1969). (In Russian).

The reflection of magneto-acoustic waves from an elastic layer was investigated, following up the author's earlier studies with electrically conducting gas or liquid layers in a homogeneous magnetic field. When magneto-acoustic waves hit an elastic layer, the polarized fast and slow magneto-elastic and electromagnetic waves, and waves polarized perpendicularly to the first three must be taken into account. Magnetohydrodynamic equations were used for analyzing the reflection. A system of linear equations was used to calculate the amplitude coefficients of reflection and transparency; in case of incidence under an oblique angle, these coefficients differ from the ordinary acoustic coefficients. In case of normal incidence, the magnetic field does not affect the amplitude coefficients. (TTT)

26044 MOTION OF A CONDUCTING LIQUID THROUGH A CHANNEL IN AN INHOMOGENEOUS MAGNETIC FIELD. Gorinov, A. S. Zh. Prikl. Mekh. Tekh. Fiz.; No. 5, 134-8(Sep-Oct 1969). (In Russian).

The motion of a nonviscous incompressible liquid in a channel with nonconducting walls was investigated at low magnetic Reynolds numbers by means of an iteration method. It was assumed that the liquid was isotropically conducting. The general relationship between the parameters was determined for the region, in which the magnetic field changes rapidly. The calculations indicated that results based on the linear theory may be applicable also when the magnetohydrodynamic parameters have finite values. (TTT)

26045 PARTIAL SOLUTIONS OF THE NONSTATIONARY MHD EQUATIONS UNDER CONSIDERATION OF THE THERMAL CONDUCTIVITY IN CASE OF FINITE VALUES OF THE MAGNETIC REYNOLDS NUMBERS. Cherepanov, A. N.; Yakovlev, V. I. Zh. Prikl. Mekh. Tekh. Fiz.; No. 5, 143-8(Sep-Oct 1969). (In Russian).

The nonstationary, plane and axially symmetric motion of a heat-conducting gas with a finite conductivity was investigated, attempting to obtain a solution when the velocity field possessed a linear dependence on the spatial coordinates. The derived system of equations was solved under the assumption that the gas satisfies the equation of state of an ideal gas and has no viscosity. Distribution of the temperature, density, and the magnetic field in the cross section of the layer was calculated as a function of the magnetic Reynolds number and a dimensionless thermal conductivity coefficient. In the calculations, the magnetic Reynolds number was allowed to vary from 1 to 10, and the thermal conductivity coefficient from 0.1 to 0.5. It was found that under the conditions used, the temperature in the upper boundary exhibits a maximum. (TTT)

26046 REVIEW OF THE IUTAM-IUPAP SYMPOSIUM ON ELECTROHYDRODYNAMICS. Melcher, J. R. (Massachusetts Inst. of Tech., Cambridge). J. Fluid Mech.; 40: 641-55(18 Feb 1970).

A Symposium on Electrohydrodynamics sponsored by the International Unions of Theoretical and Applied Mechanics and of Pure and Applied Physics was held at MIT from 31 March to 2 April 1969. Authors from eight countries presented 44 papers to an invited audience of 112. The presentations illustrated the spectrum of scientific and engineering interests in the interactions of electric fields and moving fluids. Papers were grouped in seven sessions with the following titles: Steady flows; bulk stability and dynamics; interfacial dynamics: static and steady-flow equilibria; interfacial dynamics and stability: drops; basic formulation; generation and other applications; aerosol charging and dynamics. This brief review gives only an over-all view of the Symposium. (auth)

26047 AN INVESTIGATION OF THE STABILITY OF A MAGNETOHYDRODYNAMIC SHEAR LAYER. Malcolm, D. G. (Univ. of Saskatchewan, Saskatoon). J. Fluid Mech.; 41: 531-44 (Apr 1970).

An experimental investigation of the conditions of instability and post-critical flow in an electrically driven shear layer that has been previously studied both theoretically and experimentally is presented. The shear layer forms as a primarily azimuthal flow in an electrically conducting fluid between the edges of two parallel and coaxial circular electrodes, mounted in insulating planes, when a current is passed between them in the presence of a strong, axially applied magnetic field. The aximuthal velocity at any radial position in the layer is maximum near the electrode planes and decreases to zero at the center plane between the electrodes. Radial and axial secondary velocity components apparently exist, though smaller in magnitude than the azimuthal velocity throughout most of the layer. (auth) (UK)

26048 TRANSIENT FLOW PROBLEM IN MAGNETOHYDRODYNAMICS. Soward, A. M. (Cambridge Univ., Eng.). J. Fluid Mech.; 41: 481-507(Apr 1970).

A flat plate $x = 0$, $|y| < L$ is initially at rest in an electrically conducting, inviscid, incompressible fluid permeated by a uniform magnetic field $(B_0, 0, 0)$. The plate is impulsively accelerated to a small velocity $(-U, 0, 0)$ which is then kept constant. It is assumed that $LV/\lambda \gg 1$ and $U/V \ll 1$, where V is the Alfvén velocity, and λ is the magnetic diffusivity. Four stages in the development of the flow are distinguished, the last three being: (ii) $L \gg Vt \gg (\lambda t)^{1/2}$. During this stage the initial potential flow is being disturbed by propagation of electric current and vorticity from the plate. The initial discontinuity on the plate has only propagated a small distance away compared to L, but a large distance compared to the length scale of diffusion $(\lambda t)^{1/2}$. Exact solutions to the flow are found in the neighborhood of $y = -L$ and $y = 0$ $(x = 0)$. (iii) $Vt \gg L \gg (\lambda t)^{1/2}$. The asymptotic behavior of the electric current and vorticity on the plate are determined showing that a column of fluid of length Vt moves with the plate, aligned to the magnetic field. The transverse diffusion of the current sheets bounding the column accelerates the fluid in layers of thickness $O(\lambda t)^{1/2}$. (iv) $(\lambda t)^{1/2} \gg L$. Unlike stages (ii) and (iii), where the motion is dominated by the propagation of vorticity and electric current as Alfvén waves from the plate, diffusive mechanisms completely dominate the motion. "Slug" flow is maintained. The nature of the flow, including the structure of the layers bounding the column are determined for $|x| \ll (\lambda t)^{1/2}$. (auth) (UK)

26049 ELECTROHYDRODYNAMIC INSTABILITY IN PLANE LAYERS OF FLUID. Michael, D. H.; O'Neill, M. E. (University Coll., London). J. Fluid Mech.; 41: 571-80(Apr 1970).

The instability of a plane layer of non-conducting fluid which is in hydrostatic equilibrium between two semi-infinite conducting fluids with surface charges is discussed for both inviscid and viscous fluid models. It is shown that for both the inviscid and viscous fluid cases, the criteria for instability are the same. Consideration is given to the relevance of the results in explaining the mechanism by which the presence of an electric field promotes more readily the coalescence of water droplets on a water surface by viewing the onset of disruption of the air film as the instability of the air film under the action of the electrostatic field produced by the surface charges on the water surfaces. (auth) (UK)

Geophysics (Upper Atmosphere)

Refer also to abstract 26291.

26050 (AD-700960) ELECTRON CONTENT OF BARIUM PLASMAS IN THE HIGH ATMOSPHERE. Prenatt, Raymond E.; Dean, William A.; Berning, Warren W. (Ballistic Research Labs., Aberdeen Proving Ground, Md.). Dec 1969. 49p. (BRL-1459). CFSTI.

At evening twilight on October 4, 1967 a rocket carrier released three barium clouds off Wallops Island, Virginia. The vehicle also carried a multifrequency vhf beacon for the observation of radio-frequency dispersive phase and amplitude variations in signals propagated through the release clouds, and as a derived quantity, total electron content along the propagation paths. The first cloud, at 103 km, introduced no measurable dispersive phase variations and only a brief decrease in signal strength. The other clouds at 187 and 226 km produced large and unusual effects on both dispersive phase and signal strength data. Analysis of the dispersive phase data obtained during rocket descent, when the rocket had emerged from behind the release clouds, yielded a normal electron density profile. A preliminary attempt at interpreting the data relevant to the second release employed ray tracing through spherically symmetric, diffusing cloud models with a gaussian electron density distribution. By varying the parameters defining the cloud, a model was devised that closely duplicated both the dispersive phase and signal strength data. (auth) (USGRDR)

26051 (MIT-2241-54) TOPSIDE IONOSPHERE ELECTRON DENSITY CONCENTRATION: OBSERVATION AND THEORY. Report No. 23. Wu, Mao-fou (Massachusetts Inst. of Tech., Cambridge. Dept. of Meteorology). 27 Oct 1969. Contract AT(30-1)-2241. 207p. Dep. CFSTI.

Thesis.

Anomalies have long been studied from ground-based ionosonde data. In this study, three years of Alouette I satellite data on the topside ionosphere, between the F2 peak and 1000 km, are analyzed. The equatorial anomaly and the seasonal anomaly appear clearly in the diagrams, which show similar features to those observations from the bottomside ionosphere. In addition, an electron trough in the nighttime ionosphere is verified as a permanent feature. (W.D.M.)

26052 BLANKETING-TYPE SPORADIC-E ASSOCIATED WITH THE EQUATORIAL ELECTROJET. Closs, R. L. (Univ. of Otago, N. Z.). J. Atmos. Terrest. Phys.; 32: 265-76 (Mar 1970).

The blanketing type sporadic-E, which frequently occurs with a high penetration frequency near the magnetic dip equator, is explained as a thin layer of enhanced ionization. It is shown that this enhancement could occur where the dip angle is greater than zero but less than a few degrees, and the electric intensity has a small component directed towards the equator. The variations in the horizontal intensity and the declination of the earth's magnetic field recorded at Addis Ababa (dip angle = 1.42°) appear to be consistent with this pattern of the electric intensity. It is shown how the occurrence of this type of layer would modify the scattering from wavelike irregularities arising from a two-stream or other plasma instability. (auth) (UK)

26053 ON THE THEORY OF IONOSPHERIC SCINTILLATIONS OF LUNAR RADAR ECHOES. Perona, Giovanni (Univ. of California, San Diego, La Jolla). J. Atmos. Terrest. Phys.; 32: 277-91(Mar 1970).

Different components of lunar radar echoes can be isolated using Doppler shift techniques in conjunction with continuous wave transmissions, or time delay techniques in conjunction with coherent pulsed transmissions. The shape of the region producing the echoes depends on the techniques used, which consequently should produce a definite, and possibly large, effect on the scintillations of ionospheric origin. If these scintillations can be separated from the lunar-induced scintillations, it should be possible to derive useful information about ionospheric irregularities using a single antenna instead of groups of two or three antennas distributed at various distances on the ground. (auth) (UK)

26054 AURORAL INFRASONIC AND IONOSPHERIC ABSORPTION SUBSTORMS. Wilson, Charles R. (National Center for Atmospheric Research, Boulder, Colo.). J. Atmos. Terrest. Phys.; 32: 293-301(Mar 1970).

The median global pattern for the progression of auroral absorption onsets is compared with the distribution of auroral infrasonic waves along the auroral oval. There is agreement between the directions of auroral motions as determined on one hand by the pattern of absorption onsets and on the other hand by the infrasonic wave morphology. The distribution in infrasonic wave trace velocity with respect to the auroral oval is consistent with the distribution in wave-front velocity as derived from the pattern of absorption onsets. (auth) (UK)

26055 A RE-EXAMINATION OF COLLISION FREQUENCY ESTIMATES IN THE IONOSPHERIC F AND E LAYERS FROM DEVIATIVE ABSORPTION MEASUREMENTS. Saha, A. K.; Venkatachari, R. (National Physical Lab., New Delhi). J. Atmos. Terrest. Phys.; 32: 303-14(Mar 1970).

Collision-frequency estimates through measurements of deviative absorption in the F2 layer have generally neglected the effect of magnetic field as well as height variation of collision frequency. Both these factors are taken into consideration to re-examine the results of measurements made in the past. It is found that estimates made through either pulse absorption or cosmic radio noise measurements have given quite consistent values of collision frequency. The values are, however, significantly higher than what could be expected from electron temperatures in the F region measured by rocket probe and incoherent scatter techniques. The implications of these results are discussed. E-layer collision frequency measurements by pulse absorption at a high magnetic latitude station would tend to give higher values, if proper care is not taken of the effect of the Earth's magnetic field. (auth) (UK)

26056 THE EFFECT OF IRREGULARITY SHAPE ON RADIO STAR AND SATELLITE SCINTILLATIONS. Singleton, D. G. (Weapons Research Establishment, Salisbury, Australia). J. Atmos. Terrest. Phys.; 32: 315-43(Mar 1970).

Current models of F-region irregularities include field-aligned columns, field-aligned sheets and frontal irregularities which extend many kilometers in the horizontal direction. An irregularity model is put forward which includes these shapes as special cases. Using this model and diffraction theory, a theoretical investigation is made of the effect these shapes have on (a) the nature of the variation of scintillation index with the zenith angle and azimuth of the direction of propagation at a point on the ground and (b) the shape and orientation of the characteristic ellipse of the amplitude diffraction pattern observed at the ground. It is shown that there are characteristic differences in effects (a) and (b) for each type of shape considered. The possible detection of these differences experimentally and the consequent conclusions which could be drawn regarding the nature of the scintillation producing irregularities are also discussed. (auth) (UK)

26057 THE DIURNAL VARIATIONS OF THE CONCENTRATIONS OF NO^+, O_2^+, NO, AND N IN THE IONOSPHERIC E REGION. Monro, P. E. (Univ. of Queensland, Brisbane). J. Atmos. Terrest. Phys.; 32: 373-82(Mar 1970).

The various chemical and photochemical processes leading to the production and loss of NO^+, O_2^+, NO, and N are considered to arrive at the diurnal variations of the number densities of these four constituents in the E region at a time corresponding to sunspot-minimum conditions. It is found that a large diurnal variation of the concentration of N exists and that measured values of relative ion abundances can be accounted for in terms of this variation. During the day, N is the minor constituent that is important in determining the relative ion abundance, whereas at night, NO is more important in the upper E region. The calculated concentrations of N and NO are significantly less than those measured using rocket techniques. (auth) (UK)

26058 DISPERSIVE MOTIONS OF IONOSPHERIC IRREGULARITIES. Papagiannis, Michael D. (Boston Univ.); Elkins, Terence J. J. Atmos. Terrest. Phys.; 32: 383-95 (Mar 1970).

Cross-correlation functions for satellite scintillations at spaced receivers show a systematic skewness indicative of dispersive motions of ionospheric irregularities. Other features of the correlation functions, such as secondary pumps frequently present at large time lags and a very obvious change in the shape of the curve over a long baseline are also suggestive of dispersive ionospheric wave motions. The fact that the skewness is found to be greater for a low-elevation satellite than for one at higher elevation, suggests that these motions might contain a frequency-dependent vertical component. The effects of a vertical velocity component upon the conventional horizontal spaced-receiver measurements are carefully analyzed. Useful information, relating to velocity dispersion, was also obtained at a single location, by investigating the correlation between multifrequency scintillation records of a radio star. Because of previous suggestions that apparent skewness of spaced-receiver correlation functions was due merely to statistical sampling errors, the stationarity of the scintillation data is examined in considerable detail. (auth) (UK)

26059 AN INTERPRETATION OF ASYMMETRIC CROSS-CORRELATION FUNCTIONS IN D- AND LOWER E-REGION DRIFT MEASUREMENTS. Haug, A.; Pettersen, H. (Auroral Observatory, Tromsoe, Norway). J. Atmos. Terrest. Phys.; 32: 397-403(Mar 1970).

Asymmetric cross-correlation functions frequently appear when the spaced receiver method of drift measurements is applied to reflections from the D and E regions. Examples of this are shown from an experiment using partially reflected radio waves of 2.75 MHz. It is demonstrated that a small number of individual screens moving with different velocities may explain many of the observed asymmetric cross-correlation functions. (auth) (UK)

26060 A TWO-ION MODEL OF ELECTRON-ION RECOMBINATION IN THE D REGION. Haug, A. (Auroral Observatory, Tromsoe, Norway); Landmark, B. J. Atmos. Terrest. Phys.; 32: 405-7(Mar 1970).

This note discusses the effective recombination coefficient, α_{eff}, in a D region where two positive ions, X_1^+ and X_2^+, having different recombination coefficients are present, and where the production rate of the rapidly recombining ion, X_2^+, is proportional to the number density of the more slowly recombining ion species, X_1^+. It is shown that, for the assumed model, the effective recombination coefficient α_{eff} is related to the number density N of free electrons. It is pointed out that this effect may have bearing on a number of problems in our understanding of D-region processes. (auth) (UK)

26061 INTERPRETATION OF LOSS RATES OBSERVED DURING AURORAL ABSORPTION IN TERMS OF A TWO-ION MODEL OF RECOMBINATION. Folkestad, K.; Armstrong, R. J. (Norwegian Defence Research Establishment, Kjeller). J. Atmos. Terrest. Phys.; 32: 409-12(Mar 1970).

Results from rocket observations of high-energy particles, electron density, and positive ion density are discussed. The effective loss rates derived from the observations are interpreted in terms of a two-ion model of recombination. It is shown that the interpretation is consistent with similar results obtained during quiet conditions. (auth) (UK)

26062 FIELD-ALIGNED PLASMA VELOCITY IN THE F REGION. Rishbeth, H. (SRC Radio and Space Research Station, Slough, Eng.). J. Atmos. Terrest. Phys.; 32: 413-16 (Mar 1970).

At mid-latitudes the plasma drift velocity parallel to the geomagnetic field depends on plasma diffusion and the meridional neutral air wind. Its value is closely related to the wind velocity only if the wind is poleward, thereby causing downward plasma drift. If the wind is equatorward, causing upward plasma drift, a measurement of plasma velocity gives information about the wind only if the diffusion speed can be accurately computed. When the layer is in a steady state the field-aligned velocity is related to the rate of loss of plasma, and is directed downward whichever way the wind blows. The discussion is illustrated with the aid of a simple model of the night F2 layer. (auth) (UK)

26063 FIELD-ALIGNED ION VELOCITIES IN THE F2 REGION. Bailey, G. J. (Sheffield Polytechnic, Eng.); Moffett, R. J. J. Atmos. Terrest. Phys.; 32: 417-20(Mar 1970).

Field-aligned ion velocities in the F2 region measured directly by Vasseur (1969) are compared with theoretical results. The latter results depend on altitude, as do Vasseur's. The experimental results show that in the Summer case at sunspot minimum the ion velocity changes sign around 16.00 hr L.T.; this feature is not predicted by the theoretical results. Mention is made of results that give a qualitative relation between ion velocity and the rate of loss of plasma during daytime. (auth) (UK)

26064 ELECTRIC FIELDS AND F REGION ELECTRON DENSITIES OVER PERU. Dunford, E. (Radio and Space Research Station, Slough, Eng.). J. Atmos. Terrest. Phys.; 32: 421-5(Mar 1970).

Electric fields, estimated from magnetic variations, are compared with F-region ionization parameters obtained at Jicamarca, Peru. It is shown that the changes of peak electron density and height are closely correlated with the electric field, in agreement with theory. The implications of the high correlation are briefly discussed. (auth) (UK)

26065 SEASONAL CHANGES IN THERMOSPHERIC COMPOSITION. King, G. A. M. (D. S. I. R., Christchurch, N. Z.). J. Atmos. Terrest. Phys.; 32: 433-7(Mar 1970).

There is a seasonal change in atmospheric composition near 160 km the same size as recently found near 100 km. In middle latitudes at sunspot numbers of 100 the atmosphere in Summer is more molecular than in Winter by 50%. A simple inspection of f_0F2 over many years shows that this seasonal change is very pronounced at high solar activity but disappears or even reverses at low solar activity. In Winter there is no latitudinal gradient in middle latitudes but in Summer the atmosphere is always more molecular towards the pole, and this is more pronounced at solar maximum. (auth) (UK)

26066 SOLAR CYCLE AND SEASONAL VARIATION OF SPREAD-F NEAR THE MAGNETIC EQUATOR. Chandra, H.; Rastogi, R. G. (Physical Research Lab., Ahmedabad, India). J. Atmos. Terrest. Phys.; 32: 439-43(Mar 1970).

Spread-F at equatorial stations, Ibadan, Djibouti and Kodaikanal is shown to increase with increasing solar activity. At Huancayo and other stations in the American zone there is least occurrence of spread-F in years of high solar activity. The seasonal variation of spread-F is greatest at stations in the American zone with a maximum in December and a minimum in June. At African stations a smaller seasonal variation is seen, with maximum in June and minimum in December. At Asian stations the seasonal variation of spread-F is very small. (auth) (UK)

26067 ON THE DETERMINATION OF IONOSPHERIC VELOCITY FIELDS FROM GEOMAGNETIC S/sub q/ VARIATIONS.

Moehlmann, D.; Wagner, C. -U. (Zentralinstitut Physik der Erde, Potsdam, Ger.). J. Atmos. Terrest. Phys.; 32: 445-7(Mar 1970).

The problem of calculating ionospheric winds from atmospheric dynamo effects was studied. It is shown that the complete velocity field $v_\perp$ (normal to B) can be derived from the set of dynamo equations only if the electric field as well as the current density and the conductivity tensor are taken into account. (auth) (UK)

26068 CORRELATION STUDIES BETWEEN AURORAL-ZONE X RAYS AND RADIO-WAVE ABSORPTION. Kangas, J. (Univ. of Oulu, Finland); Tanskanen, P.; Yliniemi, J. Ann. Acad. Sci. Fenn., Ser. A VI; No. 326, 16p(Dec 1969).

Simultaneous auroral-zone x-ray and cosmic noise absorption (CNA) measurements made in Finland in 1965−66 are analyzed. In general, a close correlation is found between these two phenomena thus indicating similar variations of electron fluxes in the energy range involved. The southward extension of the precipitation region is shown to be greatly dependent on geomagnetic activity. The K_p index seems to bear relation to the southward extension of high-energy auroral phenomena. Precipitation events are seen to appear at the Sodankylä latitude in 1965 during lower K_p values than in 1966. As to the production of CNA, spectral variations of electron fluxes and detachment processes are shown to be of great importance. The photochemical processes seem to be quite effective in the D region. (auth)

26069 PIONEER 6 PLASMA MEASUREMENTS IN THE MAGNETOSHEATH. Howe, Herbert C. Jr. (Massachusetts Inst. of Tech., Cambridge). J. Geophys. Res.; 75: 2429-37(1 May 1970).

Measurements of the magnetosheath plasma made by the MIT plasma experiment during the outbound passage of Pioneer 6 in the dusk meridian (December 16, 1965) are presented and compared with theoretical predictions and other simultaneous experimental measurements of the same region. Though comparison with theory indicates that the plasma flow around the Earth agrees in many ways with a gasdynamic model, observed discrepancies in the density ratio across the bow shock and the non-Maxwellian velocity distribution in the magnetosheath warrent further explanation. Proton observations in the magnetosheath next to the bow shock indicate that the non-Maxwellian high-energy tail of the proton velocity distribution may be due in part to an effect that is independent of the main flow. Magnetosphere and magnetosheath low-energy electron measurements indicate a region of anisotropic flux in the magnetosphere near the magnetopause. (auth)

26070 EQUILIBRIUM OF THE MAGNETOPAUSE. Karlson, Erik T. (European Space Research Inst., Rome). J. Geophys. Res.; 75: 2438-48(1 May 1970).

The existence of an equilibrium layer between a magnetic field and a field-free stream of cold plasma, moving perpendicularly to the field, was shown many years ago by Ferraro. Recently, Parker treated the interaction of a plasma stream and a magnetic field under somewhat different assumptions. It was assumed that the plasma stream has a velocity component parallel to the confining magnetic field, and that no potential difference can exist within the layer. From these assumptions, the conclusion was drawn that no equilibrium exists. In the present paper it is shown that a layer without any potential difference cannot be part of a self-consistent model. It is shown that at the outer border of the layer there must be a potential barrier, retarding the ions and accelerating the electrons in such a way that there is an overall charge neutrality of the stream particles within the layer. The charge neutrality of the layer will automatically ensure the equilibrium of a layer between a cold plasma stream and a magnetic field. (auth)

26071 TRANSVERSE STRUCTURE OF THE EARTH'S MAGNETOTAIL AND FLUCTUATIONS OF THE TAIL MAGNETIC FIELD. Hruska, A.; Hruskova, J. (Univ. of Alberta, Edmonton). J. Geophys. Res.; 75: 2449-57(1 May 1970).

The analysis is based on 5.46-min magnetic field averages measured by the IMP 3 satellite. The effect of the inclination χ of the Earth's magnetic axis with respect to the Y, Z plane of solar magnetospheric coordinates (perpendicular to the Earth−Sun line) is studied in detail, and a thick sheet of magnetic field depression is shown to exist around the neutral sheet at distances of 30 to 38 R_E in the antisolar direction. The location of the region of magnetic-field depression varies with the value of χ; the thickness of the depression region is about 10 R_E in the central parts of the tail, $Y \approx 0$, and is probably higher for $Y > 10$ R_E. The region of magnetic-field depression is characterized by very large, long time-scale fluctuations parallel to the average local magnetic field. A 'flapping motion' of the neutral sheet may be responsible for the large values of some of these fluctuations. The fluctuations perpendicular to local magnetic field are nearly independent of position in the magnetotail. Both types of fluctuations are enhanced during and/or after sudden storm commencements (ssc) and sudden impulses (si) observed at ground stations. The effect is more clearly seen in the perpendicular fluctuations. The information from the interaction between the magnetosphere and a discontinuity in the interplanetary medium is transferred mainly along the lines of force. (auth)

26072 PENETRATION OF LOW-ENERGY PROTONS DEEP INTO THE MAGNETOSPHERE. Chen, A. J. (Rice Univ., Houston). J. Geophys. Res.; 75: 2458-67(1 May 1970).

By using a simple model with constant convection electric field and a dipole magnetic field, plasma flow patterns are calculated with the convection fields as scale factors. Unlike other particle trajectories, the flow patterns for protons with certain relative magnetic moments show double forbidden regions: one is composed of orbits that circle the Earth; the other is composed of orbits that do not circle the Earth. These protons can penetrate very close to the Earth through the space between the two forbidden regions. The calculations based on the model of constant electric field with charge exchange as a loss mechanism indicate that protons of a few hundred electron volts convected in from the tail to L = 3 to 4 could be responsible for the storm-time ring currents. (auth)

26073 A SURVEY OF LOW-ENERGY ($E \gtrsim 5$ keV) ELECTRON ENERGY FLUXES OVER THE NORTHERN AURORAL REGIONS WITH SATELLITE INJUN 4. Craven, J. D. (Univ. of Iowa, Iowa City). J. Geophys. Res.; 75: 2468-80(1 May 1970).

Observations of the energy fluxes of $\gtrsim$5-keV electrons at low altitudes (~525 to 2500 km) over the northern auroral regions were made by the nearly polar orbiting Injun 4 satellite, from February 1965 through July 1966, during a period of minimum solar activity. Results of the first detailed survey of the percentages of occurrence of the energy fluxes of $\gtrsim$5-keV electrons (with pitch angles ~40° ± 15°) in the outer radiation/auroral zone, as a function of magnetic local time and invariant latitude, are graphically displayed for various energy-flux thresholds. The greatest occurrences of these energy fluxes were observed in the night−dawn−morning hours of local time, at latitudes from ~65° to ~70°, with median energy fluxes as great as 0.1 ergs $(\text{cm}^2 \text{ sec sr})^{-1}$. The spatial distributions of these contours are compared with those for the occurrences of optical auroras. Limited simultaneous observations of these energy fluxes at pitch angles of ~40° and ~90° have shown that the ratios of these energy fluxes are typically greater than 0.1, with a condition of isotropy occurring for energy fluxes $\gtrsim 1$ erg$(\text{cm}^2 \text{ sec sr})^{-1}$. (auth)

26074 OBSERVATIONS OF IRREGULAR STRUCTURE IN THERMAL ION DISTRIBUTIONS IN THE DUSKSIDE MAGNETOSPHERE. Taylor, H. A. (Goddard Space Flight Center, Greenbelt, Md.); Brinton, H. C.; Deshmukh, A. R. J. Geophys. Res.; 75: 2481-9(1 May 1970).

Direct measurements of the distributions of the thermal positive ions H^+ and He^+ in the magnetosphere reveal a distinct variability in the position and structure of the plasmapause. Such variability is observed to be most pronounced in the afternoon-dusk local time sector and is indicative of magnetospheric irregularities in the same region. As the OGO 3 satellite made progressive duskside (1500−1900 LT) and nightside (2200−0100 LT) passes during June−July 1966, the duskside plasmasphere was observed to exhibit an outward expansion or bulge, accompanied in some cases by considerable fine structure. In particular, the plasmapause was observed at L positions as distant as L = 7 to 8 in the afternoon−dusk sector, in contrast to positions near L = 5 to 6 observed near midnight on the same day and at comparable levels of moderate magnetic activity ($Kp \leq 3$). Within the bulge and just above the initial plasmapause, structured plasma recoveries are observed, wherein $n(H^+)$ returns to concentrations of the order of 50 to 100 ions/cm^3 over intervals of 0.5 to 1.5 L. Both the duskside bulge and fine structure are observed to persist during periods of enhanced magnetic activity ($Kp = 4$ to 6). The above variability is superimposed on an average diurnal distribution of the plasmapause that is similar in shape to that deduced from whistler data during 1963, although the 1966−1967 results place the plasmapause at a position generally more distant by about 1.5 to 2 L. (auth)

26075 DEPENDENCE OF VERY LOW-FREQUENCY ELECTRIC FIELD ANTENNA IMPEDANCE ON MAGNETOSPHERIC PLASMA DENSITY. Koons, H. C.; McPherson, D. A.; Harbridge, W. B. (Aerospace Corp., El Segundo, Calif.). J. Geophys. Res.; 75: 2490-2502(1 May 1970).

Data from a vlf electric field antenna on board the spacecraft OV3-3 show that the antenna response depends upon the local plasma density. Antenna impedances, calculated on the basis of a cold, magnetized plasma model and a warm, nonmagnetized, collisionless plasma sheath model, are compared with the data, showing that the sheath model is more appropriate. The response of the electric field antenna to constant onboard sources of electromagnetic interference is used with the antenna sheath impedance model to calculate plasma densities. The resulting densities are similar to those obtained from OGO 2 plasma density data scaled to the OV3-3 orbital parameters. The impedance of the TRW Systems Group vlf electric-field antenna, also on board OV3-3, is calculated and compared with the data. It is shown that the sheath antenna impedance model applies equally well to both antennas even though they were quite dissimilar. Much of the signal variation observed by the Aerospace and TRW electric-field antennas is caused by antenna impedance changes as a function of local plasma density. (auth)

26076 DYNAMIC SPECTRAL CHARACTERISTICS OF CHORUS AT A MIDDLE-LATITUDE STATION. **Allcock, G. McK.; Mountjoy, J. C. (Physics and Engineering Lab., Lower Hutt, N. Z.). J. Geophys. Res.; 75: 2503-10(1 May 1970).**

A study of broadband vlf data recorded during 1966 at Lauder, New Zealand (52.0°S invariant latitude), has shown that the dynamic spectra of chorus at any given time are related to the local magnetic conditions three or four hours earlier. (The K index from Macquarie, 12° poleward of Lauder, was used to describe local magnetic activity.) The mean rate of change of frequency increases markedly from 1 to 30 kHz/sec as the local K index increases from 0 to 8. The increase is due to changes in relative occurrence of four distinct types of midlatitude chorus. Each type occurs only for a limited range of magnetic conditions. The bandwidth of the chorus tones also increases with magnetic activity, the mean lower frequency of the tones decreasing from 2½ to 1 kHz, and the mean upper frequency of the tones increasing from 4½ to 6½ kHz, as the local K index increases from 0 to 8. The mean center frequency is 3.3 kHz, independent of magnetic activity. (auth)

26077 RECENT OCCURRENCES OF STABLE AURORAL RED ARCS. **Hoch, R. J. (Battelle-Northwest Labs., Richland, Wash.); Clark, K. C. J. Geophys. Res.; 75: 2511-15(1 May 1970).**

Stable auroral red (SAR) arcs were definitely recorded on nine occasions and possibly recorded on six other occasions at Richland, Washington, between September 1967 and mid-May 1969. A systematic program of photometric sky mapping and meridian spectrograms was used in collecting the data. The SAR arcs recorded were relatively faint, and all were accompanied by poleward auroral displays. It is clear that the SAR arcs are separate in latitude from the poleward auroras. New spectrographic evidence again verifies that [O I] 6300 to 6364 A is the predominant radiation of the SAR arc. (auth)

26078 STUDY OF SCINTILLATIONS AT LOW LATITUDES DURING A PERIOD FROM SUNSPOT MINIMUM TO SUNSPOT MAXIMUM. **Walker, G. O.; Chan, T. (Hong Kong Univ.). J. Geophys. Res.; 75: 2517-28(1 May 1970).**

Records taken of the 20- and 40-MHz transmissions from the satellite S 66 during the period October 1964 to July 1968 were analyzed for scintillations both north and south of Hong Kong (latitude 22.2°N, longitude 114.2°E, dip 30.5°N). Scintillation activity has been found to be greatest (1) around midnight, (2) in the summer and (3) at sunspot minimum. Three correlations were established: negative correlation between scintillation activity and solar flux, positive correlation with magnetic activity for values of ap > 30, and, for a region north of Hong Kong, positive correlation with values of f_0E_s. For values of ap from 10 to 30 the correlation with scintillation activity was found to be negative. Good positive correlation between bottom-side spread-F occurrence and scintillation activity for the region south of Hong Kong was obtained at sunspot minimum. It is considered that irregularities in the topside of the ionosphere contribute significantly to scintillation activity. Estimates of the sizes of the irregularities were made, using three independent methods and these estimates range from 0.8 to 4.7 km for heights of occurrence from 95 to 435 km. From results of the variation of normalized scintillation index with zenith angle of satellite crossing the magnetic meridian plane it seems that the field alignment effect of irregularities was obscured. Some association was observed between high scintillation activity and low electron content values for a region south of Hong Kong. (auth)

26079 F-LAYER REFLECTIONS AND ION EFFECTS IN THE PROPAGATION OF TERRESTRIAL ELF WAVES. **Galejs, Janis (Sylvania Electronic Systems, Waltham, Mass.). J. Geophys. Res.; 75: 2529-39(1 May 1970).**

At night, elf waves penetrate above the D layer, and propagation parameters of the Earth to ionosphere waveguide are dependent on the detailed ionospheric structure below the F layer. The propagation characteristics are dependent on the altitude of the F layer, the electron density below this layer, the magnitude of the radial geomagnetic field component, and also on ions that tend to increase the absorption of the penetrating magneto-ionic mode. The propagation parameters of individual ionosphere models appear to be too erratic to explain long-distance or global wave propagation, but the average of the propagation parameters derived for a number of different propagation geometries becomes comparable to the parameters deduced from a simpler isotropic ionosphere model, where waves are confined to altitudes below 100 km. (auth)

26080 POSSIBLE HYDROMAGNETIC COUPLING BETWEEN THE PERTURBATIONS OF THE NEUTRAL AND IONIZED ATMOSPHERE. **Kato, S.; Reddy, C. A.; Matsushita, S. (High Altitude Observatory, Boulder, Colo.). J. Geophys. Res.; 75: 2540-50 (1 May 1970).**

Wave motions in neutral gas give rise to disturbances in the ionization concentration in the ionosphere. The geomagnetic field and the electrostatic field in the ionosphere modify the amplitude of these disturbances but not their movement if the ambient plasma is uniform. Nonuniformity or boundary in ambient plasma makes it possible to excite disturbances that travel with velocity associated with the ion velocity along the nonuniformity. The gravity waves are an example of wave motion in neutral gas in the ionosphere, and the possibility of hydromagnetic coupling between the wave perturbations in the neutral gas and the ionization irregularities is considered in its basic aspect. (auth)

26081 PRODUCTION AND LOSS OF ELECTRONS IN THE QUIET DAYTIME D REGION OF THE IONOSPHERE. **Reid, George C. (ESSA Research Labs., Boulder, Colo.). J. Geophys. Res.; 75: 2551-62(1 May 1970).**

Rocket-probe measurements of the concentration of free electrons in the undisturbed daytime D region typically show the presence of a steep ledge in electron density at an altitude that lies between 80 and 90 km, in the vicinity of the mesopause. This paper is chiefly concerned with the interpretation of this feature. It is shown that the ledge cannot be related to a change in the primary production rate of electrons, and calculations based on existing knowledge of negative-ion reactions indicate that its presence is not likely to be related to negative-ion formation. It is concluded that the ledge probably owes its existence to a sharp change in electron–positive-ion recombination coefficient, coinciding in altitude with the sharp change in nature of the dominant positive-ion species from molecular ions above the ledge to water vapor cluster ions below. The small electron densities below the ledge can be readily explained if the complex cluster ions have recombination coefficients of the order of 50 times larger than those of simple molecular ions at mesospheric temperatures. Such large recombination coefficients may be related to a new mode of recombination available to complex cluster ions, but not to the relatively simple molecular or atomic ions. (auth)

26082 DISCUSSION OF IONIZATION EFFECTS ON THE PROPAGATION OF ACOUSTIC-GRAVITY WAVES IN THE IONOSPHERE. **Hines, C. O. (Univ. of Toronto); Hooke, W. H. J. Geophys. Res.; 75: 2563-8(1 May 1970).**

An earlier derivation of a dispersion relation for acoustic–gravity waves in partially ionized atmospheres, valid to first order in the ionospheric Pedersen and Hall conductivities, is outlined briefly, and its implications, for more recent work in this area and work yet to come are assessed critically. One major implication is that the ion effects alter the relationship between the wave angular frequency ω and the components of the wave vector k, i.e., the dispersion equation, but they cannot by themselves determine specific changes in these individual quantities separately. The specific changes must instead be determined by boundary and initial conditions, as in other problems of wave propagation. Two particular cases of interest are outlined, to illustrate the different results that can arise. (auth)

26083 ON THE SMOOTHING AND SPHERICAL HARMONIC ANALYSIS OF THE STORM OF SEPTEMBER 25, 1958. **Anderssen, R. S.; Doyle, H. A.; Petersons, H. F.; Seneta, E. (Australian National Univ., Canberra). J. Geophys. Res.; 75: 2569-77(1 May 1970).**

Smoothing techniques and a more sophisticated statistical analysis are used to obtain a more accurate spherical harmonic analysis (sha) of a D_{st} disturbance than was previously available from Chapman and Whitehead (1923), Chapman and Price (1930), Rikitake and Sato (1957), and Anderssen and Seneta (1969a). The basic factors contributing to the improvement over previous analyses are the use of (a) new and more accurate data for 51 observatories, (b) correctly formulated smoothing techniques to remove, where possible, the periodic component due to the daily variation, (c) the multi-dimensional sha model and statistical tests of its significance, and (d) orthogonal factorization techniques to generate the sha. It was found that $(e_1 + i_1)$ and sometimes $(e_3 + i_3)$ are the only statistically significant components in the multi-component sha model for the ΔX data. It was also found that either a representation for the ΔZ data as a finite number of terms involving Legendre polynomials is inappropriate, and hence the ΔZ data are not amenable to regression analysis, or the ΔZ data are too inaccurate for the successful application of the regression analysis, and that when an effort to remove the effect of the electrojet is made, a not insignificant change in the sha of both smoother and unsmoothed data is observed. (auth)

26084 LOCAL TIME BEHAVIOR OF THE ALIGNMENT AND POSITION OF A STABLE AURORAL RED ARC. Glass, N. W. (Los Alamos Scientific Lab., N. Mex.); Wolcott, J. H.; Miller, L. W.; Robertson, M. M. J. Geophys. Res.; 75: 2579-82(1 May 1970).

Airborne observations of a stable auroral red (SAR) arc occurring on May 15, 1969 (UT), were made over Australia. The results reveal a striking relationship between the alignment and movement of the arc. This suggests a dominant local time control that is operative over a few hours. A number of implications are inherent; in particular, SAR arcs have a dawn–dusk asymmetry of a type that may be controlled by plasma flow in the magnetosphere and the associated electric fields. As a further step, published data from observations on the SAR arc of September 29, 1967, are analyzed from this point of view. The results follow the same trend. (auth)

26085 METHOD TO DETERMINE SENSE AND MAGNITUDE OF ELECTRIC FIELD FROM LUNAR PARTICLE SHADOWS. Anderson, K. A. (Univ. of California, Berkeley). J. Geophys. Res.; 75: 2591-4(1 May 1970).

Lin (1968) and Van Allen and Ness (1969) have noted that the edges of shadows cast in solar electron fluxes by the Moon when in the magnetotail were sharp to within ~100 km. A method is given for determining the sense and magnitude of the electric field from lunar particle shadows. (W.D.M.)

26086 DETECTION OF GEOMAGNETICALLY ALIGNED CURRENTS ASSOCIATED WITH AN AURORAL ARC. Cloutier, P. A.; Anderson, H. R.; Park, R. J.; Vondrak, R. R.; Spiger, R. J.; Sandel, B. R. (Rice Univ., Houston, Tex.). J. Geophys. Res.; 75: 2595-2600(1 May 1970).

A rocket-borne experiment consisting of a vector magnetometer system and energetic charged-particle detectors was launched from Fort Churchill, Canada, over a stable IBC II auroral arc at 2000 LT on February 26, 1969. Vector magnetic field profiles and energetic particle flux profiles are presented which indicate the existence of geomagnetically aligned sheet currents associated with the visible auroral arc. In particular, evidence is shown that suggests that precipitated energetic electrons in the range 2 to 18 keV carry a significant fraction of the total upward field-aligned current, but that energetic particles in this range are apparently unimportant in providing the downward return current. The spatial relation of the precipitated particle structure and the auroral current configuration are discussed. (auth)

26087 MOTIONS ASSOCIATED WITH AURORAL ZONE ELECTRON PRECIPITATION. Maral, G. (Univ., Toulouse). J. Geophys. Res.; 75: 2601-5(1 May 1970).

Results concerning rapid motions associated with precipitation regions are presented. For the events reported, the most common velocity observed was about 1 km/sec. The direction of motion was different from one case to the next. It is shown that the data can be best interpreted in terms of east–west horizontal electric fields. (W.D.M.)

26088 SPATIAL SEPARATION OF λ3914- AND λ5577-A EMISSIONS IN AN AURORA. Duysinx, R.; Monfils, A. (Univ., Liege). J. Geophys. Res.; 75: 2606-7(1 May 1970).

The problem of the relation between the emissions of O I at 5577 Å and of N_2^+ at 3914 Å in polar auroras has been the subject of a long series of papers. It is generally admitted that the ratio $P = I(5577)/I(3914) \sim 2$ is roughly constant. Recently, however, various authors have shown that, if in the main part of the phenomenon the two emissions do obey the equation, then important departures may be observed at the edges, where the ratio becomes smaller than 2. A series of observations is presented that constitute a new case of departure with respect to the equation. (W.D.M.)

26089 SIGNIFICANCE OF THE IONOSPHERE–PROTONOSPHERE COUPLING FOR THE INTERPRETATION OF TOPSIDE SOUNDER PROFILES. Mayr, H. G.; Brace, L. H. (Goddard Space Flight Center, Greenbelt, Md.). J. Geophys. Res.; 75: 2608-10(1 May 1970).

An attempt is made to demonstrate through the solution of energy and continuity equations that, dropping the restrictive and arbitrary assumption of diffusive equilibrium, a suitable and realistic choice of the proton flux allows one to reproduce accurately the topside sounder profiles discussed by Colin et al. (1969), while, simultaneously, the energy equation for the plasma can be satisfied without requiring negative electron or plasma temperature gradients at higher altitudes. (W.D.M.)

26090 REDISTRIBUTION OF IONIZATION BY THE MERIDIONAL CURRENTS ASSOCIATED WITH THE EQUATORIAL ELECTROJET. Closs, R. L. (Univ. of Otago, Dunedin, N. Z.). J. Geophys. Res.; 75: 2611-12(1 May 1970).

Sugiura and Poros (1969) presented a new model of the equatorial electrojet that includes the meridional current systems. This model could lead to the formation of a thin layer of enhanced ionization by a mechanism similar to that suggested by Whitehead (1961) to explain the formation of midlatitude sporadic E by wind shear. An attempt is made to estimate the vertical component of the ion velocity at various heights, latitudes, and longitudes. (W.D.M.)

26091 DISCUSSION OF ROCKET NIGHTGLOW DATA OF I. S. GULLEDGE, D. M. PACKER, S. G. TILFORD, AND J. T. VANDERSLICE. Peterson, Vern L. (Aeronomy Lab., Boulder, Colo.). J. Geophys. Res.; 75: 2613-17(1 May 1970).

Gulledge et al. (1968) presented new rocket observations of the predominant F-region nightglow emissions: the 6300-Å ($^1D \rightarrow {}^3P$) and 5577-Å ($^1S \rightarrow {}^1D$) lines of atomic oxygen. From their analysis of these data they concluded that the rate coefficient for the quenching of O (^1D) by N_2 is about 1×10^{-11} cm^3 sec^{-1}. Because this number is some 5 to 10 times smaller than that deduced from other experiments it was felt important to reexamine the analysis. A reanalysis is presented which shows that these rocket data are not inconsistent with the larger quenching indicated by the other experiments. The efficiencies of producing O(^1D) and O(^1S) atoms by the dissociative recombination of O_2^+ and electrons are also estimated. A reply by Gulledge et al., is included to the effect that Peterson's treatment does not appreciably change the original conclusion. (W.D.M.)

26092 IONOSPHERIC PROBING USING VERTICAL INCIDENCE SOUNDING TECHNIQUES. Eccles, D.; King, J. W. (Radio and Space Research Station, Slough, Eng.). J. Atmos. Terrest. Phys.; 32: 517-38(Apr 1970).

Ionospheric probing using vertical incidence sounders both on the ground and in satellites is discussed. The type of information which can be obtained by means of sounders, the difficulties encountered in using the sounding technique, and possible future developments are considered. (auth) (UK)

26093 IONOSPHERIC PROBING USING CONTINUOUS WAVES AT OBLIQUE INCIDENCE. Eccles, D.; King, J. W.; Bradley, P. A. (Radio and Space Research Station, Slough, Eng.). J. Atmos. Terrest. Phys.; 32: 539-49(Apr 1970).

Three different ionospheric probing techniques which all use continuous waves at oblique incidence are discussed. These are (a) the high-frequency Doppler technique in which the Doppler frequency shifts caused either by vertical ionospheric movements or by ionization changes are studied, (b) the forward-scatter of vhf waves from the ionosphere and (c) the study of radio aurorae using bistatic systems in which the transmitter and receiver are situated several hundred kilometres apart, but both on the equator side of the auroral irregularities. The type of ionospheric information which can be obtained using each of the three techniques, the limitations of the techniques and the future research which needs to be done are all discussed. (auth) (UK)

26094 ION TEMPERATURE SENSITIVE END EFFECT IN CYLINDRICAL LANGMUIR PROBE RESPONSE AT IONOSPHERE SATELLITE CONDITIONS. Hester, S. D.; Sonin, Ain A. (Massachusetts Inst. of Tech., Cambridge). Phys. Fluids; 13: 1265-74(May 1970).

Computations and experiments are presented for an end effect which can dominate the ion current response of long, cylindrical Langmuir probes in high-speed collision-free flows. The end effect, which takes the form of an increase in ion current when the probe is aligned with the flow direction, depends strongly on the plasma properties and flow speed, and can be large even for very long probes when the speed ratio is large and the probe radius small compared with the Debye length. Experimental data are compared with theory, and some apparently contradictory results reported in the literature are reconciled in terms of the end effect. (auth)

Low-Temperature Physics

Refer also to abstracts 25337, 26326, and 26348.

26095 (NASA-SP-5057, pp 259-80) CRYOGENICS AND SUPERCONDUCTIVITY. Nored, Donald L.; Laurence, James C.

NASA-sponsored activities in the areas of technology pertinent to the interests of the electrical industry in applications involving cryogenic temperatures are reviewed. After brief introductory remarks about superconductors and cryogens, the discussion is centered around three main topics: (1) cryogenic magnets, (2) cryogenic handling and storage, and (3) cryogenic transmission lines. For illustrative purposes, 12 figures and 12 pictures are included. (L.M.T.)

26096 NEW PHASE BOUNDARY FOR CERIUM. King, E. (Atomic Energy Research Establishment, Harwell, Eng.); Lee, J. A.; Harris, I. R.; Smith, T. F. Phys. Rev., B; 1: 1380-1(15 Feb 1970).

The phase boundary for the high-pressure superconducting α' phase of cerium was determined from 77 to 480°K from observations of the resistance anomaly that occurs at the $\alpha \rightarrow \alpha'$ transition. The observed transition pressure at 297°K is 55.8 ± 0.5 kbar, varying linearly with temperature with $\partial P/\partial T = -34.9$ bar/deg. The change in the electronic properties of cerium as a function of pressure is discussed. (auth)

26097 EFFECT OF MECHANICAL VIBRATION ON THE STRUCTURE OF CAST, SUPERCONDUCTING ALLOYS OF NIOBIUM CONTAINING TIN. Savitskii, E. M.; Mikhailov, B. P.; Baron, V. V. (Inst. of Metallurgy, Moscow). Dokl. Akad. Nauk SSSR; 189: 1000-2(11 Dec 1969). (In Russian).

The microstructures of cast alloys containing 35 wt % niobium and 65 wt % tin were determined after crystallization with and without vibration. Two zones are clearly visible in the ingot crystallized without vibration. The upper zone contains two phases of tin and dendrites of Nb_3Sn. The lower zone consists of three phases of tin, Nb_3Sn and niobium carbide Nb_2C. The upper zone showed a microhardness of 10 to 16 kg/cm^2, and the lower zone 90 to 115 kg/mm^2. The microstructure and properties did not vary within these zones. Gas bubbles and porosity were noted. On vibrating the sample, four zones were observed. The top zone A consisted of tin and homogeneously distributed particles of Nb_3Sn. The next zone B contained 1) tin, 2) Nb_3Sn and niobium carbide Nb_2C. Zone C contained the same phases with a finer grain structure, and the bottom zone D consisted mainly of Nb_3Sn and niobium carbide Nb_2C. The hardnesses for zones A, B, C, and D were respectively: 10 to 12 kg/mm^2, 90 to 100, 250 to 300, and 450 kg/mm^2. The ingot was finer-grained, and showed no gas bubbles or porosity. The superconducting transition temperatures of all ingots varied from 17.2 to 17.8°K. (TTT)

26098 SUPERCONDUCTIVITY OF METASTABLE GALLIUM PHASES IN POROUS MEDIA. Bogomolov, V. N.; Malkovich, R. Sh.; Chudnovskii, F. A. (Inst. of Semiconductors, Leningrad). Sov. Phys.-Solid State (Engl. Transl.); 11: 2295-9(Apr 1970).

Translated from Fiz. Tverd. Tela; 11: 2835-40(Oct 1969).

Superconductivity was investigated of gallium introduced under a pressure of ~14 kbar from a melt into porous media such as cellulose (wood pulp, pressed wadding), into pressed corundum powders, and also synthetic zeolites (NaA, NaX, and FeNaX) and into a porous glass (pore size ~30 to 70 Å). In the temperature range studied (4.2 to 16°K), two superconducting transitions were observed—in the range from 6.1 to 6.4°K and between 6.8 and 7.2°K. The first transition is ascribed to the metastable phase β-Ga and the second to another metastable phase called δ-Ga. These phases have previously been observed in thin films and in gallium emulsions. The formation of the δ phase is accompanied by more gallium dispersion than in the case of the β phase. The larger part of gallium in channels in porous glass is not superconducting above 4.2°K. In a number of porous glasses and zeolites, a smeared signal was observed which is poorly suppressed by a magnetic field. This signal can either be identified with the "tail" of some low-temperature ($T < 4.2$°K) transition of gallium in channels or ascribed to a small portion of metastable gallium in the channels. (auth)

26099 CRITICAL CURRENT IN TWO-BAND SUPERCONDUCTORS. Golub, A. A.; Kolpazhiu, M. K. (Inst. of Mathematics and Computer Center, Kishniev, USSR). Sov. Phys.-Solid State (Engl. Transl.); 11: 2337-9(Apr 1970).

Translated from Fiz. Tverd. Tela; 11: 2887-9(Oct 1969).

An expression is found for the critical current in a thin-film two-band superconductor on the basis of the Ginzburg—Landau equations. It is shown that a broad band (s-band) has a greater influence on the critical current than on the critical thermodynamic magnetic field. The case of a high concentration of a nonmagnetic impurity is also considered. (auth)

26100 CHANGE OF CRITICAL TEMPERATURES OF SUPERCONDUCTING METALS IN POROUS GLASSES AND IN FILMS. Bogomolov, V. N.; Malkovich, R. Sh.; Chudnovskii, F. A. (Inst. of Semiconductors, Leningrad). Sov. Phys.-Solid State (Engl. Transl.); 11: 2483-4(Apr 1970).

Translated from Fiz. Tverd. Tela; 11: 3053-5(Oct 1969).

The critical temperature T_{cf} of a thin film or a metal in porous glass exceeds the bulk critical temperature T_{cb}. An attempt is made at a unified interpretation of this difference, assuming an equation of the Bardeen—Cooper —Schrieffer type and that the increase of T_c in a film arises from a change of Q and V which is common to different metals. The following equation is derived: $\lg T_{cf}/T_{cb} = \lg Q_f/Q_b + 0.43\,(1/NV_b)\,[1-(V_b/V_f)]$. T_c was measured for Hg, Pb, Sn, In, and Ga in porous glass with 100-Å pores. The data, together with literature data on films, were plotted on a graph of $\log (T_{cf}/T_{cb})$ vs $1/NV_b$; from the slope $(0.43[1-(V_b/V_f)])$ and intersection $(\log Q_f/Q_b)$, Q_f/Q_b is found to be 0.5 and $V_f/V_b =$ 1.4. This value of 1.4 is close to the factor of $^3/_2$ predicted by the boundary effect. The still larger T_c in sandwiches is due to Q_f approaching Q_b. Thus, the change of T_c of a metal in a finely dispersed state is due to the effects of the boundary on the motion of electrons and phonons. (D.L.C.)

26101 FLUCTUATIONS IN JOSEPHSON CONTACT. Ivanchenko, Yu. M.; Zil'berman, L. A. (Donetsk Technical Inst., Kiev). Zh. Eksp. Teor. Fiz.; 58: 211-25(Jan 1970). (In Russian).

The behavior of a superconducting tunnel contact in the presence of thermal fluctuations is investigated. In contrast to the case considered previously (Zh. Eksp. Teor. Fiz., 55: 2395(1968)) the transverse dimensions of the transition are not considered small. One must therefore assume that the fluctuations introduced from the external circuit and arising within the contact act differently and in the general case cannot be taken into account by introducing some effective temperature. The dependence of the stationary current component on the magnetic field and the Josephson radiation spectra are calculated. The dependences may strongly differ from those previously known. It is possible that some of the results obtained have been observed experimentally. (auth)

26102 A METHOD FOR OBSERVING PERIODICITY OF A VORTEX LATTICE IN ROTATING He II. Finkel'shtein, A. M. (Inst. of Theoretical Physics, Novosibirsk, USSR). Zh. Eksp. Teor. Fiz.; 58: 341-7(Jan 1970). (In Russian).

A method is suggested for observing the periodicity of a vortex lattice by scattering light on He II ions. Negative ions in rotating He II tend to concentrate on the vortexes. Thus, coherent scattering of light in a plane perpendicular to the axis of rotation will have a diffraction maximum, providing the vortex lines form a regular lattice. In order to assess the feasibility of such an experiment the behavior of a quasi-neutral mixture of ions in rotating He II is considered. (auth)

26103 SUPERFLUID GROUND STATE OF NEUTRON MATTER AND OTHER STRONGLY INTERACTING MANY-FERMION SYSTEMS. Clark, J. W.; Yang, C.-H. (Washington Univ., St. Louis). Lett. Nuovo Cim.; 3: 272-6(26 Feb 1970).

The beginnings of a new method for investigating pairing effects (superfluidity) in such strongly interacting Fermi systems as the neutron gas, nuclear matter, finite nuclei, and liquid ^{3}He are described. The BCS treatment of the superfluid state is extended in the same way as Jastrow (Phys. Rev., 98: 1479(1955)) extended the Hartree—Fock treatment of the normal state; thereby, strong short-range correlations are incorporated at the outset, obviating the difficulty intrinsic in earlier work. (W.D.M.)

26104 FLUX-FLOW VISCOSITY COEFFICIENT OF TYPE-II SUPERCONDUCTORS IN THE MIXED STATE. Chow, W. S. (Univ. of Cincinnati). Phys. Rev., B; 1: 2130-3(1 Mar 1970).

The finite-temperature flux-flow viscosity coefficient of type-II superconductors in the mixed state is studied in the low-magnetic-field region. Both the effect of the penetration of the electric fields due to the surface charge distribution of the normal core of one flux line into the normal core regions of its neighboring flux line and the effect of the thermal conduction are included. The latter is particularly important for dirty type-II superconductors. It is shown that for dirty type-II superconductors in a low-magnetic field there exists a resistance minimum at a certain temperature T_{min}, and that this temperature decreases with increasing magnetic field. This is in good agreement with the experimental data given by Kim, Hampstead, and Strnad. The Hall angles for both the pure and the dirty type-II superconductors in the low-field region are shown to be consistent with the high-field experimental data, thus, explaining some of the mysterious features of the high-field data. (auth)

26105 HIGH-FIELD SURFACE IMPEDANCE OF DIRTY TYPE-II SUPERCONDUCTORS IN THE VORTEX STATE. Fischer, Gaston (Univ. of Montreal); McConnell, R. D.; Monceau, P.; Maki, Kazumi. Phys. Rev., B; 1: 2134-9(1 Mar 1970).

Surface-impedance data, obtained in the vortex state of dirty type-II superconductors, are presented. In the geometry considered, the dc magnetic field H is perpendicular to the sample surface. The data are explained in terms of the mechanism of flux-flow resistance. A theoretical expression is derived which predicts a frequency-independent surface resistance R(H) in the vicinity of the upper critical field H_{c2}. This theoretical expression accounts well for the experimental R(H) data at temperatures such that the microwave energy $\hbar\omega$ is below the intrinsic pair-breaking energy $\epsilon_0(t)$. The quantitative comparison of experiments and theory indicates that strong-coupling effects can be taken into account, replacing the weak-coupling relation $(4\pi\sigma D)^{-1} = 4\kappa_1^2(0) = 4\kappa_2^2(0)$ by $(4\pi\sigma D)^{-1} = 4\kappa_2^2(0) \neq 4\kappa_1^2(0)$. At high temperatures, when $\hbar\omega \gtrsim \epsilon_0(t)$, the absorption is larger than predicted by the flux-flow mechanism, because near T_c dynamical fluctuations of the order parameter provide an additional, frequency-dependent mechanism of absorption. This is satisfactorily accounted for if one retains the frequency-dependent terms in the expression derived for the conductivity. (auth)

26106 THEORY OF FLUX-FLOW NOISE VOLTAGE IN SUPERCONDUCTORS. Clem, John R. (Ames Lab., Iowa). Phys. Rev., B; 1: 2140-55(1 Mar 1970).

A theory of the time-dependent measured voltage and its associated power spectrum is developed for conditions of magnetic flux flow in the mixed and intermediate states of superconductors. Expressions for the measured voltage, appropriate for flux flow, are given and discussed. The case of a semi-infinite superconductor containing a single moving fluxoid is then examined as an illustrative model, and potentials and fields are calculated from a London-model description. The resulting time-dependent voltage pulses are computed and shown to depend upon the spatial configuration of the measuring circuit leads. The measured time-dependent flux-flow voltage and the power spectrum arising from an array of fluxoids are formulated and found to depend upon the measuring-circuit configuration, the internal flux distribution, the effects of pinning, and the modes of flux motion. Previous experimental results by van Gurp are interpreted as lending support under certain conditions to a description in terms of flux-line dislocation dipoles proposed by Kramer. New experiments are suggested as tests of the theory. (auth)

26107 PAIR CONDUCTIVITY ABOVE T_c IN ALUMINUM FILMS. Masker, W. E.; Parks, R. D. (Univ. of Rochester, N. Y.). Phys. Rev., B; 1: 2164-9(1 Mar 1970).

Pair conductivity, as reflected in the temperature dependence of the electrical resistance above the superconducting transition temperature, was studied in aluminum films in the "two-dimensional" regime, viz., $d \lesssim \xi(T)$, where d is the film thickness and $\xi(T)$ is the superconducting coherence length. Normal-state resistivities were varied over five orders of magnitude, the highest-resistance films having highly disordered granular structures and the lowest-resistance films having mean free paths as large as 400 Å. The predicted temperature dependence of the pair conductivity was found to hold irrespective of sample parameters. However, the prediction that the excess conductivity should be independent of mean free path was found not to hold: low-resistivity films exhibited an excess conductivity an order of magnitude larger than that predicted by Aslamazov and Larkin. (auth)

26108 DIAMAGNETIC SUSCEPTIBILITY AT THE TRANSITION TO THE SUPERCONDUCTING STATE. Prange, R. E. (Rutgers-The State Univ., New Brunswick, N. J.). Phys. Rev., B; 1: 2349-50(1 Mar 1970).

An expression of Schmid for the "extra" diamagnetic susceptibility is evaluated to facilitate comparison with the experiments of Gollub et al., [Phys. Rev. Lett., 22: 288(1969)]. (auth)

26109 ELECTRONIC PROPERTIES OF THE SUPERCONDUCTOR IN THE TRANSITION REGION. Marcelja, S. (Univ. of Rochester, N. Y.). Phys. Rev., B; 1: 2351-3(1 Mar 1970).

The calculations of Abrahams, Redi, and Woo, which give the electronic properties above the superconducting transition, are extended into the "critical region" of the transition. (auth)

26110 NEW MAGNETIC PHENOMENON IN TYPE-II SUPERCONDUCTORS. LeBlanc, M. A. R. (Univ. of Ottawa); Mattes, H. G. J. Appl. Phys.; 41: 1567-72(15 Mar 1970).

The variation of a transverse magnetic field induces a magnetic moment along the axis of a cylinder of a hysteretic type-II superconductor provided that a static axial field is present. It is argued that an axial moment appears perpendicular to the inducing field in order to relax the magnetic pressure or Lorentz forces. The observations show that the induced electric currents do not flow exactly along the direction of the impressed (induced) electric fields. (auth)

26111 QUANTUM PHASE FLUCTUATIONS IN RESISTIVE CIRCUITS CONTAINING WEAKLY SUPERCONDUCTING JUNCTIONS. Harding, J. T.; Zimmerman, J. E. (Philco-Ford Corp., Newport Beach, Calif.). J. Appl. Phys.; 41: 1581-8(15 Mar 1970).

Experimental evidence is presented which shows that quantization of the phase integral is not a necessary condition for the occurrence of quantum interference effects in superconducting weak-link circuits. Interference patterns observed with weak-link geometries containing resistive sections differ from their superconducting counterparts only in the effect of Johnson noise which causes a random walk in quantum phase. (auth)

26112 PROPERTIES OF DILUTE SOLUTIONS OF ^{3}He IN LIQUID ^{4}He AT LOW TEMPERATURES. Oestgaard, E. (Univ. of California, San Diego). Phys. Rev., A; 1: 1048-62(Apr 1970).

Using an effective interaction or reaction matrix obtained from a modified Brueckner theory, various low-temperature properties are calculated or estimated for dilute solutions of ^{3}He in liquid ^{4}He. The system is regarded as a low-density Fermi liquid with ^{3}He quasi particles created by ^{3}He atoms in superfluid ^{4}He. The single-particle energy spectrum is given by an effective mass, and an effective interaction between the ^{3}He quasi particles is derived. The calculations are done for two different two-body potentials: an Yntema-Schneider potential given by Brueckner and Gammel, and a Frost-Musulin potential given by Bruch and McGee. The Landau f function is estimated from the reaction matrix, and the coefficients of the expansion of the Landau f function in terms of Legendre polynomials are calculated. The estimated values are in reasonably good agreement with experimental results. The exclusion-principle sum rule is also roughly satisfied by the lowest-order coefficients. Low-temperature properties, such as the compressibility, the quasi-particle effective mass or specific-heat ratio, and the magnetic susceptibility, are estimated; results are in fair agreement with experimental values. The various properties are also given as functions of the ^{3}He concentration in the solution, and the maximum solubility of ^{3}He in liquid ^{4}He is estimated in good agreement with the experimental value. Also, transport coefficients—i.e., viscosity, thermal conductivity and spin diffusion—are estimated after identification of the reaction matrix with the scattering amplitude in the formulas developed by Abrikosov and Khalatnikov and by Hone. The agreement with experimental results is surprisingly good, considering that the results depend very much on the value chosen for the effective mass. (auth)

26113 WAVE-RADIATION MODEL FOR THE ONSET OF DISSIPATION AT THE ROTON CRITICAL VELOCITY IN SUPERFLUID HELIUM. Takken, Edward H. (Ohio State Univ., Columbus. Naval Research Lab., Washington, D. C.). Phys. Rev., A; 1: 1220-39(Apr 1970).

A linearized form of the Gross-Pitayevski (GP) equation is used to calculate the rate at which quasiparticles are created by a small sphere moving through a superfluid at a velocity greater than $(\omega_k/k)_{min}$, the Landau roton critical velocity. Because the excitations described by the linearized GP equation can be given a hydrodynamic interpretation, the qualitative features of the model proposed here for the roton critical velocity are analogous to the many critical-velocity phenomena of classical physics. The quantitative results of the model indicate that energy dissipation sets in so rapidly that, once the creation of quasiparticles is allowed kinematically, it should be impossible experimentally to force a negative-ion complex to move observably faster than the roton critical velocity. An investigation of the meaning of the linearized GP equation is also given. (auth)

26114 HEAT TRANSPORT THROUGH HELIUM II: KAPITZA CONDUCTANCE. Snyder, N. S. (National Bureau of Standards, Boulder, Colo.). Cryogenics; 10: 89-95(Apr 1970).

A review is presented of experimental and theoretical work on the Kapitza conductance, which limits the heat that can be transferred from a solid to helium II. A short derivation of the phonon radiation limit indicates the reason for the approximate T^3 temperature dependence of the Kapitza conductance. The small size of this upper limit makes the Kapitza conductance a critical factor in He II heat transfer applications. Considerable qualitative and quantitative correspondence of the data with this limit is found. From the limited evidence available, the role of surface conditions and bulk parameters in determining the conductance are considered empirically. An examination of the theories of Kapitza conductance which have been proposed shows that none provide adequate explanations of the data, and that the underlying physical phenomena remain obscure. Because of the scarcity of available data, and discrepancies between experiments, the prediction of Kapitza conductance for design purposes from theory of experiment is difficult. (auth) (UK)

26115 HEAT TRANSPORT THROUGH HELIUM II. Arp, V. (National Bureau of Standards, Boulder, Colo.). Cryogenics; 10: 96-105(Apr 1970).

Heat transport through He II is summarized in terms of the hydrodynamics of the two-fluid model. With increasing thermal flux, three regimes are identified, depending on the development of vorticity in the superfluid component and the development of a classical turbulence in the normal component. Calculation of summary curves of thermal gradient as a function of thermal flux is explained, and graphical results presented. An estimate of the limiting thermal flux for inception of vapor formation within He II is made, and time-dependent effects are discussed. The presentation is oriented towards use of He II in the nominal range from 1.5 to 2.1 K; special effects near the λ-point (2.17 K) are not considered, nor are conductivity changes below about 0.6 K due to rapid decreases of roton contributions. (auth) (UK)

26116 IONS IN He II AT 1°K. I. VELOCITY DISCONTINUITIES. Cope, J. A.; Gribbon, P. W. F. (Univ. of St. Andrews, Scotland). J. Phys., C (London); 3: 460-71(Feb 1970).

In a study of the mobility of ions in liquid He II in the temperature range 0.89 to 1.0°K, the existence of the sharp periodic velocity discontinuities, first detected by Careri, was confirmed. The discontinuities were found to occur at integral values of a critical drift velocity $v_c^+ = 5.21 \pm 0.08$ m s^{-1} for positive ions, and $v_c^- = 2.12 \pm 0.16$ m s^{-1} for negative ions. Velocities were measured by a time-of-flight method, and at low values of the grid-source field, the previously undetected first discontinuity of the negative ions was found. Measurements were made of the magnitude $\Delta\mu$ and shape of the first three discontinuities. The constant $\Delta\mu$ values found for successive discontinuities and the observed lack of dependence of $\Delta\mu$ on the grid-collector separation are in disagreement with the predictions of the vortex-ring creation theory of Huang and Olinto. The proposal is made that the discontinuities are not hydrodynamic in origin but are associated with ionic excitation into vibrational states. These states may be produced by a specific type of inelastic ion–roton collision in which the forward motion of the ion is reduced during dethermalization of the roton. The decrease in forward velocity of the ion is then responsible for the discontinuity. The flight path of the ion is assumed to be analogous to a Franck–Hertz process. (auth) (UK)

26117 IONS IN He II AT 1°K. II. HEAT FLUSH EFFECTS. Cope, J. A.; Gribbon, P. W. F. (Univ. of St. Andrews, Scotland). J. Phys., C (London); 3: 472-80(Feb 1970).

The effect of a turbulent counter flow of liquid He II on the drift velocity of ions has been studied in a triode cell near 1°K. It was found that when the ion drift velocity in the applied field and the normal fluid flow were in the same direction then the apparent ion velocity was enhanced with a velocity increase greater than the maximum normal fluid velocity through the holes of the grid, while the critical velocity for a discontinuity was only slightly affected by the normal fluid flow. Negative ions were more strongly affected than positive ions. The results were consistent with the trapping of ions in superfluid turbulence. The ions were trapped and then released closer to the collector so that their flight distance and, hence, their measured time of flight was effectively shortened to give an apparent increase in velocity. With trapping present it was not possible to determine whether the critical velocity of a discontinuity was to be considered as a velocity with respect to the superfluid or to the normal fluid. The origin and the spatial distribution of the turbulence are discussed and it is concluded that ion trapping occurred in superfluid vorticity which had been fed back with the normal fluid passing through the grid holes. A re-interpretation of the Gaeta diode experiment is proposed in terms of the recombination of ions trapped in the vorticity produced by the high-energy particles emitted from the source. (auth) (UK)

26118 BRILLOUIN SCATTERING FROM SUPERFLUID ^{4}He. Pike, E. R. (Royal Radar Establishment, Malvern, Eng.); Vaughan, J. M.; Vinen, W. F. J. Phys., C (London); 3: L40-3 (Feb 1970).

Brillouin scattering at 90° from thermally excited first sound in superfluid ^{4}He was measured with a Fabry-Perot etalon and digital scanning. The line shifts confirm that there is no dispersion compared with low-frequency orthodox measurements over the range of temperature 1 : 25K to 2 : 15°K. (auth) (UK)

26119 WAVE EQUATION FOR THE MACROSCOPIC WAVE FUNCTION IN SUPERCONDUCTORS. Taylor, A. W. B. (Univ. of Liverpool). J. Phys., C (London); 3: L52-5(Feb 1970).

The time-dependent wave equation for the macroscopic pair wave function in superconductors is derived in a macroscopic manner from the assumption of off-diagonal long-range order and the neglect of long-range three-particle correlations. It is shown that the equation is satisfied in equilibrium by the conventional microscopic theory. (auth) (UK)

26120 THE DECAY OF A THICK He II FILM. Nicolson, I. K. M.; Gribbon, P. W. R. (Univ. of St. Andrews, Scotland). Phys. Lett.; 31A: 437-8(20 Apr 1970).

Optical observations were made of the time of decay of a vertical He II film from a flooded condition to the equilibrium thickness. The dominant process controlling the decay appears to be the van der Waals force. (auth)

26121 A PROPOSAL FOR AN EXPERIMENTAL DETERMINATION OF THE EQUILIBRIUM CONDENSATE FRACTION IN SUPERFLUID HELIUM. Hyland, G. J. (Univ. of Warwick, Coventry, Eng.); Rowlands, G.; Cummings, F. W. Phys. Lett.; 31A: 465-6(20 Apr 1970).

A method of obtaining the temperature dependence of the condensate fraction n_0/N is presented, which involves only measurement of the liquid structure factor. (auth)

26122 KINETICS OF THE DESTRUCTION OF TYPE I SUPERCONDUCTIVITY BY A CURRENT. Posada, E.; Rinderer, L. (Univ., Lausanne, Switzerland). Phys. Lett.; 31A: 445-6 (20 Apr 1970).

The destruction of type I superconductivity by a current in a cylindrical tin wire was studied experimentally. The values obtained for the transition time are compared with recently published theoretical results. (auth)

26123 A SIMPLE MODEL FOR THE TIME-DEPENDENT GINZBURG–LANDAU EQUATION. Bergmann, G. (Univ., Goettingen, Ger.). Z. Phys.; 234: 70-3(1970).

A semiclassical model of the superconducting state, originally developed by de Gennes, is generalized for a time-dependent energy gap. In this way a time-dependent gap equation is obtained. By Taylor expansion, one finds the time-dependent Ginzburg–Landau equation. (auth)

26124 THERMAL-CONDUCTIVITY MEASUREMENTS OF GAPLESS BEHAVIOR PRODUCED BY THE PROXIMITY EFFECT. Deutscher, G.; Lindenfeld, P.; McConnell, R. D. (Rutgers–The State Univ., New Brunswick, N. J.). Phys. Rev., B; 1: 2169-76 (1 Mar 1970).

The thermal conductivities K_s and K_n in the superconducting and normal states were measured for six In–Bi films of varying thickness with Mn layers on each side. The graphs of K_s/K_n against T show the characteristic linear variation of gapless systems near the transition temperature. In contrast to the expected behavior, K_s/K_n approaches a finite value at low temperatures. This is interpreted in terms of localized states near the n–s boundary, which cause gapless behavior at all temperatures. (auth)

26125 VIBRATING SAMPLE MAGNETIC IMAGE EFFECTS IN AN Nb_3Sn SOLENOID. Richards, D. B.; Edwards, L. R.; Cornforth, C. M.; Legvold, S. (Ames Lab., Iowa). Rev. Sci. Instrum.; 41: 647-9(May 1970).

Serious difficulties encountered with a vibrating sample magnetometer in an Nb_3Sn ribbon wound superconducting solenoid are described. A useful sensitivity of 10^{-4} emu was achieved, but absolute accuracy was severely limited by unstable magnetic image effects which precluded proper calibration. It is suggested that use of large-bore solenoids will overcome the basic difficulties. (auth)

26126 FLUX CREEP IN TYPE-II SUPERCONDUCTORS. Beasley, M. R.; Labusch, R.; Webb, W. W. (Cornell Univ., Ithaca). Phys. Rev., 181: 682-700(May 10, 1969).

Measurements were made of the evanescent decay of the irreversible magnetization induced by magnetic cycling of solid superconducting cylinders in order to elucidate the mechanisms of Anderson's thermally activated flux-creep process. A superconducting quantum interferometer device coupled to the creep specimen by a superconducting flux transformer made possible observations of flux changes with a resolution of one part in 10^9. The general applicability of Anderson's theory of flux creep was confirmed and the results were analyzed to show that: (1) The total flux in the specimen changed logarithmically in time, i.e., $\Delta\phi \propto \ln t/t_0$. (2) The logarithmic creep rate $d\phi/d \ln t$ is proportional to the critical current density J_c and to the cube of the specimen radius. (3) The logarithmic creep rate appears to be only weakly temperature-dependent because a proportionality to T is nearly compensated by the proportionality to J_c, which decreases as T increases. (4) The creep process is a bulk process that is not surface-limited (in this case). (5) Flux enters and leaves the surface in discrete events containing from about one flux quantum up to at least 10^3 flux quanta. (6) On departing from the critical state to a subcritical condition, the creep process tends to remain logarithmic in time, but the rate is decreased exponentially by decreasing T and is decreased extremely rapidly by backing off of the applied field from the critical state. (7) At magnetic fields $H < H_{c1}$ on the initial magnetization curve, no flux creep was observed, but the logarithmic creep rate showed a modest increase above H_{c1} and a broad rise as H approached H_{c2}. The creep process is characterized by a dimension parameter VX consisting of a flux bundle volume V and pinning length X, and by an energy U_0, both of which are supposed to be material-sensitive parameters characteristic of the irreversible processes. These parameters were determined from the experiments. Bundle volumes $V \approx 10^{-12}$ cm^3 and energies $U_0 \approx 1$ eV were found, indicating that groups of fluxoids must be pinned and must move cooperatively. The results are found compatible with a recent model for flux pinning that includes these cooperative effects. (auth)

26127 RESISTIVITY MEASUREMENT OF V_3Si SINGLE CRYSTAL IN THE MIXED SUPERCONDUCTING STATE. Goldberg, I. B.; Ehrenfreund, E.; Weger, M. (Hebrew Univ., Jerusalem). Solid State Commun.; 8: 555-9(Apr 1970).

Measurements of the resistivity of a V_3Si single crystal in the mixed superconducting state, near the critical temperature T_c indicate a sharp peak in the critical field H_x for the onset of resistivity. In the (100) direction, H_x is approximately five times larger than in the vicinity of this direction, and the width of the peak in H_x is approximately 2.5°. The crystal had been subjected to stress of order 50 kg/cm^2 in the (100) direction. A tentative explanation is suggested which takes into account the domain structure caused by the martensitic transformation. The sharp peak and the large anisotropy are attributed to the possibility that the domain walls act as potential barriers to the flux flow. (auth) (UK)

26128 FRICTIONAL FORCE ON A MOVING FLUXON. Lowell, J. (Univ. of Manchester, Eng.). J. Phys., C (London); 3: 712-21(Mar 1970).

The origin of the frictional force between pinning sites and moving fluxons was investigated. It was shown that the elastic distortion introduced by the pinning sites gave rise to a frictional force which in general depended on the velocity of the fluxons. If the current was appreciably greater than the critical current, however, the frictional force was essentially independent of velocity (in agreement with experiment) unless the current was extremely large, in which case the frictional force vanished. The experimental fact that the frictional force was of the same order of magnitude as $\phi_0 J_c$ implied that the critical current J_c depended on the elastic constants of the fluxons as well as on the pinning forces. (auth) (UK)

26129 HETERODYNE DETECTION WITH SUPERCONDUCTING POINT CONTACTS AND ENHANCED HETERODYNE SIGNALS FROM TIGHTLY COUPLED CONTACTS. Zimmerman, J. E. (Philco-Ford Corp., Newport Beach, Calif.). J. Appl. Phys.; 41: 1589-93(15 Mar 1970).

Several modes of operation of point contacts as heterodyne detectors in the frequency range 0 to 10^{10} Hz were investigated experimentally. A point contact in a superconducting loop, under the application of two externally generated ac fields, behaved as expected on the basis of a model given previously. Likewise, a point contact in a partly resistive loop, in which an externally generated signal is heterodyned with the Josephson oscillation of the contact, gave the expected results. In both cases the heterodyne signal amplitude exhibits a decaying oscillatory (Bessel-function-like) dependence on applied signal level; the heterodyne power at the first peak being approximately $0.1\phi_0^2 f_0/L$, where f_0 is the heterodyne frequency, L the loop inductance, and ϕ_0 the flux quantum. On the other hand, an anomalously large heterodyne signal was obtained from a pair of closely coupled Josephson-oscillating contacts. No explanation of this result is offered, but it appears that a sort of amplification of the heterodyne signal is effected when the Josephson frequencies are larger than the heterodyne frequency. (auth)

26130 PHONON EMISSION BY QUASI-PARTICLE DECAY IN SUPERCONDUCTING TUNNEL JUNCTIONS. Kinder, H.; Laszmann, K.; Eisenmenger, W. (Univ., Goettingen, Ger.). Phys. Lett.; 31A: 475-6(20 Apr 1970).

Improved measurements on phonon emission and detection by tunnel junctions show qualitative agreement with a numerical evaluation of Tewordt's theory on quasi-particle lifetime. (auth)

26131 FUNCTIONAL INTEGRALS REPRESENTING MANY-BODY GREEN FUNCTIONS, AND THEIR EVALUATION BY SADDLE POINT METHODS. Blomberg, Clas (Royal Inst. of Tech., Stockholm). Ark. Fys.; 39: 529-49(1969).

The general chain of equations for the Green functions of a many-particle system is written in the form of functional equations, and, formally solved in terms of integrals in a complex function space. Saddle-point methods are suggested to treat these integrals. These methods yield approximation procedures, which can be looked upon as generalizations of molecular field methods. The methods are developed from the treatment of an ordinary type of integral in a complex space, which general structure is related to the physical problems. The methods are useful both for "normal" and superfluid systems, and provide a kind of generalized Hartree approximation. For theory of superconductivity, they yield pair correlations directly, and a set of generalized BCS equations, which contain higher orders of correlations. (Sweden)

26132 CRITICAL FIELD IN THE Ti-Nb-V SYSTEM. Bellin, P. H.; Gatos, H. C.; Sadagopan, V. (Massachusetts Inst. of Tech., Cambridge). J. Appl. Phys.; 41: 2057-9(Apr 1970).

The superconducting resistive critical field H_r of the bcc region of the Ti-Nb-V ternary system was studied. Measurements at 4.2°K on cold-rolled alloys at 10 at.% composition intervals determined that H_r varied smoothly with composition. A maximum in H_r occurred at a valence electron to atom ratio n of 4.4 for pseudobinaries of the system. The ratio of critical field to transition temperature was found to be a function of n alone in qualitative accord with the theory for type-II superconductors. A criterion for predicting the behavior of similar systems is presented. (auth)

26133 THE CONDENSATION COEFFICIENT OF LIQUID HELIUM II. Hunter, G. H.; Osborne, Donald V. (Univ. of East Anglia, Norwich, Eng.). J. Phys., C (London); 2: 2414-24(Dec 1969).

The condensation coefficient (defined as the fraction of gas atoms striking the liquid-vapor interface which crosses it to form part of the liquid) was measured for liquid helium II from 1°K to the λ point, and was found to be not less than 0.90 and probably unity. The measurements, made by reflecting second sound pulses from the surface, are not in agreement with the macroscopic theories of Osborne and of Chernikova; the former theory gives agreement with experiment when modified to take account of conditions in the vapor a fraction of a mean free path above the surface. The problem of providing a microscopic interpretation of these results is briefly discussed. (auth) (UK)

26134 MICROSCOPIC QUANTUM THEORY OF THE HELIUM LIQUIDS. Feenberg, Eugene (Washington Univ., St. Louis). Amer. J. Phys.; 38: 684-704(Jun 1970).

A highly developed microscopic theory of the helium liquids exists based on the Schrödinger equation involving realistic forms of the interaction potential between pairs of neutral atoms. A tutorial review of the microscopic theory is presented with emphasis on the method of correlated basis functions. Among the topics considered are potentials, distribution functions, consequences of the correspondence principle, working approximations for the three-particle distribution function, useful matrix elements, sum rules, the paired-phonon function space, trial forms for the ground state of the boson system, distribution of particles in momentum space, elementary excitations, basis functions, and matrix elements for liquid ^{3}He and for the dilute solution of ^{3}He in liquid ^{4}He. (auth)

26135 THEORY OF RESISTIVE ANOMALY IN A SUPERCONDUCTOR ABOVE A SECOND-ORDER CRITICAL MAGNETIC FIELD. Tilley, D. R.; Parkinson, J. B. (Univ. of Essex, Eng.). J. Phys., C (London); 2: 2175-80(Dec 1969).

The time-dependent Ginzburg-Landau equation was used to calculate the effect of thermodynamic fluctuations in lowering the resistance below the normal-state value for magnetic fields above a second-order critical field. Only dirty metals in the Ginzburg-Landau temperature region were considered and the conductivity of a bulk specimen along and transverse to the applied field was evaluated. There was a strong anisotropy in the effect: $\sigma_{zz} \propto (H-H_{c2})^{-3/2}$ but $\sigma_{xx} \propto (H-H_{c2})^{-1/2}$, where the z axis was along the magnetic field. The results are in agreement with a recent microscopic calculation by Usadel. (auth) (UK)

26136 INDUCTIVE COUPLING OF JOSEPHSON JUNCTIONS TO EXTERNAL CIRCUITS. Owen, C. S.; Scalapino, D. J. (Univ. of Pennsylvania, Philadelphia). J. Appl. Phys.; 41: 2047-56 (Apr 1970).

The inductive coupling between a Josephson junction and a superconducting stripline is calculated. In the overlapping region they share a superconducting film, the structure having superconducting (S) and insulating layers (I) sandwiched S-I-S-I-S. The coupling arises from the magnetic field penetration through the common superconductor. An equivalent circuit representation is exhibited which has the same modes and coupling as the original system. Using the circuit analog, the power transfer is calculated for several cases of interest: (a) power is radiated outward in the stripline from a biased junction and (b) power is absorbed by the junction from a source coupled to the stripline. The criterion for matching the tunnel junction to the stripline is discussed. (auth)

26137 CHARACTERISTIC LENGTHS λ AND ξ OF BCS THEORY. Cleary, Robert M. (Univ. of Illinois, Urbana). Phys. Rev. Lett.; 24: 940-1(27 Apr 1970).

The calculations of Eilenberger and Buettner are misleading in the regime where λ and ξ are complex. The regime of validity of linear-response theory is studied in calculating the asymptotic properties of plane boundary and vortex structure. On this basis, it is not possible to predict if a sufficiently clean low-κ type-II superconductor such as niobium or vanadium will exhibit field reversal at low temperatures. (auth)

26138 GALILEAN RELATIVITY, LOCALITY, AND QUANTUM HYDRODYNAMICS. Garrison, John C.; Morrison, Harry L.; Wong, Jack (Univ. of California, Livermore). J. Math. Phys. (N. Y.); 11: 630-4(Feb 1970).

The consequences of locality and Galilean covariance for the operators that occur in Landau's quantum hydrodynamics are studied. The following requirements are considered: (1) Galilean covariance of the velocity field, (2) locality of the velocity field, and (3) Landau's assumption that the momentum density is a symmetrized product of the velocity and density operators. It is demonstrated that the density–velocity commutation relation of the Landau theory is essentially a direct consequence of (1) and (2). The addition of (3) is sufficient to determine the velocity–velocity commutation relation, also in agreement with Laudau. It is further shown that the density–velocity commutation relation, independent of (3) or any specific form for the velocity field, is inconsistent with the nonnegative character of the local density. (auth)

Plasma and Thermonuclear Physics

26139 INTERNATIONAL CONFERENCE ON PHYSICS OF QUIESCENT PLASMAS, PROCEEDINGS, PARIS, SEPTEMBER 8-13, 1969. PART I. Paris; Ecole Polytechnique (1969). 187p. (In English and French). (CONF-690923-(Pt.1)).

Separate abstracts were prepared for the 21 papers included. (M.O.W.)

For abstracts of individual papers see: 26147, 26160, 26170, 26207, and 26264–26280.

26140 INTERNATIONAL CONFERENCE ON PHYSICS OF QUIESCENT PLASMAS, PROCEEDINGS, PARIS, SEPTEMBER 8-13, 1969. PART II. Paris; Ecole Polytechnique (1969). 202p. (In English and German). (CONF-690923-(Pt.2)).

Separate abstracts were prepared for the 23 papers included. (M.O.W.)

For abstracts of individual papers see: 26148, 26171, 26172, 26183, 26184, 26208–26211, 26230–26234, 26239, 26240, and 26281–26287.

26141 INTERNATIONAL CONFERENCE ON PHYSICS OF QUIESCENT PLASMAS, PROCEEDINGS, PARIS, SEPTEMBER 8-13, 1969. PART III. Paris; Ecole Polytechnique (1969). 171p. (In English and French). (CONF-690923-(Pt.3)).

Separate abstracts were prepared for the 21 included papers. (M.O.W.)

For abstracts of individual papers see: 25973, 25974, 26161–26167, 26185, 26186, 26212, 26213, 26218–26221, and 26241–26244.

Confinement and Heating

Refer also to abstract 25475.

26142 (NP-17949) DATA ON RESEARCH IN NUCLEAR FUSION REACTIONS. Artsimovich, L. A.; Tanyel, Besim (Atomic Energy Commission, Ankara (Turkey)). 1969. 28p. (In Turkish). Dep.

The basics of fusion reactions are briefly described and the research state of the art at midyear, 1969, is summarized. (TSS)

26143 PRELIMINARY EXPERIMENT ON THE PLASMA CONFINEMENT IN THE TOROIDAL HELIOTRON P FIELD. Oshiyama, Hiroshi; Tsuda, Takashi; Ueda, Yoshio (Kyoto Univ.). Kakuyugo Kenkyu; 24: 252-63(Jan 1970). (In Japanese).

The possibility of confining plasma by the toroidal Heliotron P field (T.H.P. field) is studied preliminarily. The plasma, with ion temperature of 20 eV and electron temperature of 5 eV, is axially injected into the above field through a small aperture limiter with 15-mm diameter. The radial density profile, the overall decay time of plasma density, and the end flow are measured for some typical configurations of T.H.P. field. T.H.P. field shows the good effectiveness of plasma confinement compared to the Heliotron C field. The confinement time is about 15 times as large as Bohm time. (auth)

26144 OBSTACLE INDUCED CONVECTION IN A TOROIDAL OCTUPOLE. Schmidt, J. A.; Schmidt, G. L. (Univ. of Wisconsin, Madison). Phys. Fluids; 13: 1351-4(May 1970).

The effects of hoop supports and other obstacles penetrating the plasma containment region of a toroidal octupole were determined. Obstacles produced large-scale convective cells that move plasma toward the field boundary at the azimuth of the obstacles and toward the separatrix at other azimuths. Under certain obstacle bias conditions, 3-V floating potential steps were observed across a dummy support along with 100% density steps. The density step showed an exponential dependence on the obstacle bias potential. A model is discussed that predicts the observed properties of the potential and density steps. Electron cooling at the obstacle was also detected. (auth)

26145 EFFECTS OF SPATIAL VARIATIONS ON COLLISIONAL LOSSES IN A MIRROR-CONFINED PLASMA. Marx, K. D. (Sandia Labs., Livermore, Calif.). Phys. Fluids; 13: 1355-71(May 1970).

The results of a numerical procedure for solving a spatially dependent Fokker–Planck equation for plasmas in mirror-confinement systems are presented. Ion distributions are evaluated as functions of speed and angle in velocity space, while the electron distribution is assumed to be approximately isotropic and Maxwellian (except for the absence of particles in the loss region). Ion–electron interactions are accounted for, as well as ambipolar potential effects. In addition, the effects of variations in plasma parameters along field lines are included by integrating sources and losses along guiding-center orbits. Data from several sample calculations are given to illustrate the effects of spatial dependence, variations in particle current and mirror ratio, and slow-ion trapping. (auth)

26146 PLASMA HEATING AND CONFINEMENT: CONTROLLED NUCLEAR FUSION. Hatch, Albert J. (Argonne National Lab., Ill.). pp 347-64 of Microwave Power Engineering. Vol. 2. /Okress, Ernest C. (ed.). New York; Academic Press Inc. (1968).

The basics for controlled fusion are discussed. Various aspects of the hf properties of plasmas, plasma-loaded cavities, and typical systems are described. (M.O.W.)

26147 MEASUREMENTS OF DIFFUSION IN VELOCITY SPACE FROM ION-ION COLLISIONS AND ION-WAVE MICROTURBULENCE. Wong, A. Y.; Baker, D. R. (Univ. of California, Los Angeles). pp 1-13 of International Conference on Physics of Quiescent Plasmas. Pt. I. Paris; Ecole Polytechnique (1969).

See CONF-690923(Pt.1).

By means of the spatial ion-wave echo, which is highly phase sensitive, effects were measured of small-angle ion–ion collisions in regimes where ion waves are normally insensitive to such collisions. A quantitative agreement between theoretical and measured echo amplitude demonstrates that the Fokker–Planck diffusion operator is adequate for describing the velocity space diffusion of particles in a highly ionized low-pressure plasma. The ion-wave echo was also used to measure the diffusion of ions due to interaction with a turbulent spectrum. The results for ion wave turbulence differ from that of electron wave turbulence in that all waves travel with the same phase velocity, and all waves interact with the particles that make up the echo. The experimental measurements yield results which agree within a factor of 2 with those calculated from theory. (auth)

26148 PLASMA CONFINEMENT IN A Q MACHINE WITH ROTATIONAL SYMMETRIC TEMPERATURE DISTRIBUTION AT THE END PLATES. Guilino, E.; Troppmann, M. (Institut fuer Plasmaphysik GmbH, Garching, Ger.). pp 117-25 of International Conference on Physics of Quiescent Plasmas. Pt. II. Paris; Ecole Polytechnique (1969).

See CONF-690923(Pt.2).

With the aid of a rotating cathode, heating deviations of the temperature distribution of the end plates from rotational symmetry were minimized. In this way, the ion mean lifetime is increased to 270 ms at low density. Above certain critical densities, plasma confinement seems to be determined by end-plate recombination, resistive and end-plate diffusion. Very likely, this "classical" behavior remains conserved under conditions where a weak electron sheath is present in front of the emitter. Remaining anomalous losses occurring at high electron sheath are not identified in this experiment. However, the high degree of symmetry of the temperature distribution suggests that mechanisms other than temperature gradient drifts are responsible. (auth)

Diagnostics

26149 (AD-697997) STUDIES OF LOW DENSITY PLASMAS WITH GAS LASERS. Interim Report, July 1, 1966–July 1, 1969. Verdeyen, J. T.; Cherrington, B. E. (Illinois Univ., Urbana. Gaseous Electronics Lab.). Sep 1969. Contract AF33(615)-5248. 95p. (ARL-69-149). CFSTI.

The use of the gas laser to study the refractive index of a plasma is described. It is shown that the sensitivity of the laser interferometer can be greatly enhanced by utilizing the transverse modes of an external spherical cavity. The parameters that determine the sensitivity of a spherical laser interferometer are discussed, and detailed theory of such is given. The plasma to be studied can be located in the external cavity or inside the laser cavity. The latter geometry preserves the excellent spatial resolution of the laser and also the high sensitivity of the spherical geometry. In order to achieve even higher sensitivity to very small changes in plasma refractivity, the laser heterodyne system was evolved. This was applied at the three common He : Ne laser wavelengths of 0.6328, 1.15, and 3.39 μ. The latter transition is especially attractive because of its high gain and inherent sensitivity to the presence of the free electrons in a plasma. However, mode pulling effects at 3.39 μ are quite serious and a technique was developed to evaluate it. (auth) (USGRDR)

26150 (AD-700307) EXPERIMENTAL STUDY OF A HOLLOW-CATHODE ARGON ARC PLASMA. Technical Report, July 1966–June 1968. Holt, James F.; Boyer, Ellsworth L. (Air Force Aero-Propulsion Lab., Wright-Patterson AFB, Ohio). Sep 1969. 30p. (AFAPL-TR-69-76). CFSTI.

A set of coaxial cathode tubes produced a plasma having the same characteristics as the plasma from a tubular hollow cathode. Measurements of the plasma characteristics by microwave interferometry, plasma sweeper, Langmuir probe, and measurements made with a new plasma tool — a plasma scanner — showed that the plasma is nearly completely ionized at 10^{13} cm^{-3} ion density. The electron beam, originating in the cathode, was detected by means of the scanner. The electrons in the beam attain energies as high as two-thirds of the arc voltage drop. The ion temperature of 6.9 eV, which was deduced from plasma sweeper measurements and diffusion theory, could result from directed ion drift; the electron temperature of the plasma is 3 eV. (auth) (USGRDR)

26151 (AD-701083) CONICAL ELECTROSTATIC PROBES IN A CONTINUUM FLOWING PLASMA. Dukowicz, John K. (Cornell Aeronautical Lab., Inc., Buffalo, N. Y.). Jan 1970. Contract DAHC60-68-C-0016. 62p. (CAL-AN-2755-Y-1). CFSTI.

A theory is presented for electrostatic probes used in continuum flowing plasmas under conditions when charged-particle diffusion effects can be neglected in comparison with the effects of convection and the electric field. The theory is applied to the case of a 10° half-angle conical probe in an incompressible, inviscid flow field. Calculated results are presented for a range of parameters. The theoretical results are compared with the results of shock tube experiments with conical probes in which the electron number density was measured independently by microwave interferometers operated at Ka band and X band. It is found that while the qualitative behavior of the probe current is well described, the electron number density predicted by the theory is approximately twice the expected value on the average. This discrepancy is believed to be primarily due to the difference between the actual supersonic flow field and the assumed flow field. (auth) (USGRDR)

26152 MEASUREMENT OF THE TRANSFER IMPEDANCE OF A HIGH FREQUENCY QUADRUPOLE PROBE. Renard, Claude; Debrie, Roland (Orleans Univ., France). Compt. Rend., Ser. B; 270: 649-52(2 Mar 1970). (In French).

The transfer impedance of a quadrupole probe immersed in a hot magnetoplasma was measured at high frequencies. As predicted by the theory of the probe in a cold magnetoplasma, the impedance shows a maximum at the high hybrid frequency of the medium. This theory does not take into account the fact that measurements depend on the Debye length and on the radius of gyration of the electrons in the medium. (France)

26153 MICROWAVE INTERFEROMETER FOR CRYOGENIC AFTERGLOW PLASMA STUDIES. Boulmer, Jacques; Vauge, Christian (Paris Univ., Orsay, France). Compt. Rend., Ser. B; 270: 573-6(2 Mar 1970). (In French).

A microwave interferometer working in the X band to measure electron densities from 10^8 to 10^{12} cm^{-3} in recurrent afterglow plasmas is described. The experimental results reveal the high sensitivity and the wide measurement range of this apparatus. (France)

26154 ELECTRON-BEAM ECHO. Hinton, F. L.; Kaware, T. (Princeton Univ., N. J.). Phys. Fluids; 13: 1212-16(May 1970).

The existence of an electron-beam echo is demonstrated, and its properties are described. The use of the beam echo as a diagnostic for fluctuations in a plasma is discussed. (auth)

26155 SMALL-DIMENSION COOLED MAGNETIC PROBES. Prikhodov, V. Yu. Teplofiz. Vys. Temp.; 7: 1044-5(Sep-Oct 1969). (In Russian).

Small-dimension galvanometric Hall transducers easily shifted and cooled were designed as magnetic probes for stationary plasma diagnostics. The construction and performance of two types of small-dimension cooled magnetic probe transducers: (the two-cavity probe and coaxial probe) are described and compared. The technology of the two-cavity probe proved more cumbersome than that of the coaxial type. Moreover, the designed coaxial probe differed from the previously constructed probes by its smaller size which reduced, considerably, the perturbations of plasma parameters. The experiments also confirmed the impossibility of coaxial-type probes with external diameter less than 9.5 mm. (R.V.J.)

26156 USE OF THERMOANEMOMETER-LANGMUIR PROBE FOR RAREFIED PLASMA DIAGNOSTICS. Khazen, A. M.; Shuvalov, V. A. (Moscow State Univ.). Teplofiz. Vys. Temp.; 7: 866-72(Sep-Oct 1969). (In Russian).

Local parameters of nonisothermal plasma of high-frequency discharge in helium were measured at 0.12 mm Hg and 0, 50, 70, and 90 Oe magnetic fields. (tr-auth)

26157 PROBE MEASUREMENTS IN THE RAREFIED PLASMA JET. Luk'yanov, G. A.; Petukhov, G. V. (Leningrad Inst. of Tech.). Teplofiz. Vys. Temp.; 7: 842-5(Sep-Oct 1969). (In Russian).

Properties of Langmuir probes for measuring parameters of supersonic rarefied argon plasma jets are discussed, and the measuring methods are described. Data on axial distribution of electron concentration and temperatures in the initial region of the plasma jet are analyzed. (tr-auth)

26158 USE OF ATOMIC TEMPERATURES FOR PLASMA DIAGNOSTICS AT MEDIUM PRESSURES. Kagan, Yu. M.; Khristov, N. N. Opt. Spectrosc. (USSR)(Engl. Transl.); 27: 311-13(Oct 1969).

Translated from Opt. Spektrosk.; 27: 573-7(Oct 1969).

The radial distribution of temperature in the positive column of a discharge was calculated. The temperature on the axis was measured spectroscopically. Electron concentrations on the axis were calculated from the measurements. (auth)

26159 USE OF THE CONTINUOUS SPECTRUM OF HELIUM FOR MEDIUM-PRESSURE PLASMA DIAGNOSTICS. Kagan, Yu. M.; Khristov, N. N. Opt. Spectrosc. (USSR)(Engl. Transl.); 27: 388-9(Oct 1969).

Translated from Opt. Spektrosk.; 27: 710-11(Oct 1969).

A formula taken from an earlier paper was used for determining the electron density in the positive column of a discharge in the pressure range 10 to 80 torr at currents of 100 and 200 mA. Measurements were taken of the discharge and compared with theory. (M.O.W.)

26160 DETERMINATION OF ION ENERGY PARAMETERS USING ELECTROSTATIC DISTURBANCES IN A Q MACHINE. Korn, P.; Marshall, T. C.; Schlesinger, S. P. (Columbia Univ., New York). pp 39-46 of International Conference on Physics of Quiescent Plasmas. Pt. I. Paris; Ecole Polytechnique (1969).

See CONF-690923(Pt.1).

The plasma ion drift velocity was measured and an estimate was obtained of the ion thermal velocity parallel to the magnetic field in a single-ended Q machine by electronically gating the plasma flow from the hot ionizer and observing the subsequent one-dimensional evolution of the spatial density discontinuity. The results are compared with earlier measurements. (M.O.W.)

26161 STANDING RADIAL WAVES AS DIAGNOSTIC TOOLS. Moore, Richard L. (Douglas Aircraft Co., Long Beach, Calif.). pp 111-17 of International Conference on Physics of Quiescent Plasmas. Pt. III. Paris; Ecole Polytechnique (1969).

See CONF-690923(Pt.3).

Experimental evidence is shown that the main Tonke–Dattner resonance is independent of the charge in dielectric constant of the plasma discharge tube container. This result then leads to the conclusion that this type of resonance should occur in other plasmas that are nonuniform in the radial direction, and also in most laboratory plasmas. After a summary of the inviscid theory, the approximate effect of viscosity on the radial oscillations in a nonuniform plasma is given. The theory is then applied to several experiments that range from rf scattering from plasma columns to self-excited oscillations in a Q machine to dynamic confinement in a theta pinch. (M.O.W.)

26162 OPTICAL DETERMINATION OF LOW-BARIUM PLASMA DENSITY. Motz, Robin O. (Stevens Inst. of Tech., Hoboken, N. J.). pp 119-26 of International Conference on Physics of Quiescent Plasmas. Pt. III. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.3).

A differential measurement was made of the absorption of a collimated beam of Ba II resonance radiation passing through the plasma. The experimental apparatus and some measurements of the plasma density are given. (M.O.W.)

26163 USE OF TUNED LASER RADIATION TO BOTH DIAGNOSE AND ENHANCE THE LOCAL CONDITIONS WITHIN AN ALKALI PLASMA. Measures, R. M. (Univ. of Toronto). pp 127-34 of International Conference on Physics of Quiescent Plasmas. Pt. III. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.3).

The use of tuned laser radiation to pump the resonance lines of an alkali metal plasma in order to achieve a relatively high electron density from an otherwise low-temperature thermal plasma is discussed. The use of tuned laser radiation to measure the local conditions within alkali-like plasmas is also discussed. (M.O.W.)

26164 EFFECT OF PLASMA ACCESS HOLES IN MICROWAVE RESONATORS USED FOR DETERMINATION OF ELECTRON DENSITY. Dreicer, H.; Rich, W. F. (Los Alamos Scientific Lab., N. Mex.). pp 135-40 of International Conference on Physics of Quiescent Plasmas. Pt. III. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.3).

The electron density of (low-density) plasma columns is often measured with a microwave resonator surrounding the column. Plasma passes through two access holes in the walls of the resonator. These are generally connected to metal tubing which is operated below cutoff to prevent microwave leakage. This technique, which depends upon a measurement of the resonator's frequency shift when plasma is introduced, is approximately 25 years old. The Los Alamos LALA computer code was used for the cylindrical TM010-like mode to evaluate the integrals that appear in the well-known perturbation formula for frequency shift and Q change. These integrals include the effects of the fringe fields, which have been ignored previously. The effect upon frequency shift and Q change is found to increase as either the ratio of resonator radius to height or the ratio of access hole radius to resonator radius increases. Near cyclotron resonance the effect of of the radial fringe field becomes very large. Away from resonance the effect may still be appreciable. For example, a typical resonator can produce a frequency shift which is 15% lower at zero magnetic field and in very large magnetic fields is 25% lower than the frequency shift evaluated for the perfect TM010 mode unmodified by access holes. (auth)

26165 DENSITY MEASUREMENTS BY MICROWAVES IN A Q MACHINE. Mills, P.; Schmitt, J. (Ecole Polytechnique, Paris). pp 141-7 of International Conference on Physics of Quiescent Plasmas. Pt. III. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.3).

Two methods for making microwave measurements are briefly discussed, namely, cavity and extraordinary-wave methods. (M.O.W.)

26166 ION AND ELECTRON TEMPERATURE MEASUREMENTS IN Q MACHINES. Buzzi, J. M.; Doucet, H. J.; Gresillon, D. (Ecole Polytechnique, Paris). pp 149-56 of International Conference on Physics of Quiescent Plasmas. Pt. III. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.3).

A heated Langmuir probe and an electrostatic analyzer are used in a single-ended Q-machine plasma. Classical measures of electronic and ionic temperature, density, and plasma potential as well as electrode work functions are improved, and for plasma density smaller than 5×10^8 cm^{-3}, the ion-parallel velocity distribution function is deduced from the analyzer characteristic. (auth)

26167 INCREASED-SENSITIVITY HOLOGRAPHIC TECHNIQUES FOR PLASMA DIAGNOSTICS. Friedrich, Otto M. Jr.; Weigl, Frederic; Dougal, Arwin A. (Univ. of Texas, Austin). pp 157-64 of International Conference on Physics of Quiescent Plasmas. Pt. III. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.3).

Multipass holographic techniques and two-wavelength, single-exposure holographic techniques for increased sensitivity are briefly discussed. (M.O.W.)

Kinetics (General)

26168 PARAMETERS OF STATIONARY INDUCTION DISCHARGE AT ATMOSPHERIC PRESSURE. Trekhov, E. S.; Fomenko, A. F.; Khoshev, Yu. M. (Moscow Engineering Physics Inst.). Teplofiz. Vys. Temp.; 7: 860-5(Sep-Oct 1969). (In Russian).

Spatial distribution of high-frequency magnetic fields in a stationary discharge plasma in air and in argon at atmospheric pressure was measured by magnetic probes. Experimental data and Maxwell equations were used for determining the electric field voltage phase angles and active resistance input reduced to the units of the lengths of discharge. Theoretical and experimental data are compared and correlated. (tr-auth)

26169 MICROWAVE-POWERED PLASMA SPACE PROPULSION. Kosmahl, Henry G. (Lewis Research Center, Cleveland). pp 365-77 of Microwave Power Engineering. Vol. 2. /Okress, Ernest C. (ed.). New York; Academic Press Inc. (1968).

The following topics are discussed: (1) theory of plasma acceleration with microwaves, (2) coupling of microwave power to a plasma near or at cyclotron resonance, (3) collisionless model of plasma acceleration, (4) collision-dominated plasma acceleration, and (5) applications to space propulsion. (M.O.W.)

26170 RADIATION CHARACTERISTICS OF AN ANTENNA IN A PLASMA. Shen, K.; Aksornkitti, S.; Hsuan, H. C. S.; Lonngren, K. E. (Univ. of Iowa, Iowa City). pp 23-30 of International Conference on Physics of Quiescent Plasmas. Pt. I. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.1).

Antenna radiation patterns of a longitudinal wave in an isotropic plasma that agrees reasonably well with the predicted pattern was observed. Limitations may be imposed by the use of the far-field approximation in the calculation, neglecting any inhomogeneities in the plasma. The final results are also similar to radiation patterns found in ordinary acoustic waves that are also longitudinal waves. (auth)

26171 INFLUENCE OF THE COULOMB INTERACTION ON THE DIFFUSION OF A HIGHLY IONIZED PLASMA IN A MAGNETIC FIELD. Fuchs, Gerhard (Univ., Marburg, Ger.). pp 181-8 of International Conference on Physics of Quiescent Plasmas. Pt. II. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.2).

A plasma was produced by contact ionization on a heated tungsten helix spanned in the axis of a cylindrical glass vessel containing Cs vapor. Measurements were made of the plasma diffusion by Langmuir probes. Calculations for diffusion are also presented. (M.O.W.)

26172 POSITIVE COLUMN IN A MAGNETIC FIELD AND TRANSITION OF NORMAL TO ANOMALOUS DIFFUSION. Janzen, G. (Univ., Stuttgart); Moser, F.; Raeuchle, E. pp 189-96 of International Conference on Physics of Quiescent Plasmas. Pt. II. Paris; Ecole Polytechnique (1969). (In German).
See CONF-690923(Pt.2).

The instability of a diffusion-dominated positive column of a gas discharge is investigated theoretically and experimentally. A theoretical explanation of this instability was given first by Kadomtsev and Nedospasov (J. Nucl. Energy, Part C: Plasmaphysics 1: 230 (1960)). The influence of finite length of the plasma column on the criteria of instability was examined. Dispersion relations and regions of instability are calculated numerically. It is shown that a finite length of the column leads to an increase of the critical magnetic field calculated by Kadomtsev and Nedospasov, who considered infinite length. The theoretical results are derived for a density distribution (Bessel-type) of a positive column of a gas discharge. Measurements are performed in a neon discharge. The length of the positive column is varied by means of a movable anode system. (auth)

Kinetics (Experimental)

Refer also to abstracts 25973, 25974, and 25982.

26173 (AD-698039) ENHANCED LOSSES IN MAGNETO-PLASMA COLUMNS. Final Report, March 26, 1966–November 25, 1969. Oakes, M. E.; Lindman, E. L. (Texas Univ., Austin. Dept. of Physics). 7p. (AROD-6398:7-P). CFSTI.

The study of enhanced diffusion in a radio-frequency magnetoplasma was completed. Several candidates for the experimentally observed instability are suggested. Theoretical work on the problems associated with feedback stabilization through generalized boundary conditions was focused on two problems: (1) the effect of the sheath, and (2) the question of whether active elements are needed in the stabilizing network. (auth) (USGRDR)

26174 (AD-699202) A ROSS FILTER SYSTEM FOR MEASURING X-RAY SPECTRA IN Z-PINCH PLASMA FOCUS DEVICES. Report for July 1967–July 1968. van Paassen, Hugo L. L. (Aerospace Corp., El Segundo, Calif.). 1 Jul 1969. Contract F04701-69-C-0066. 18p. (TR-66(5220-50)-7; SAMSO-TR-69-395). CFSTI.

The development of plasma pinch and other flash x-ray devices has created the need for a system capable of measuring the spectra of 50-nsec x-ray pulses. A Ross filter system that measured both the integrated and time-resolved x-ray spectra from several plasma pinch devices is described. Filters made from readily available materials were used in conjunction with both film and solid-state detectors to measure x-ray spectra between 5.46 and 115.6 keV. (auth) (USGRDR)

26175 (CTO-677) BEHAVIOUR OF A PLASMA PRODUCED BY OHMIC HEATING IN THE "URAGAN" HIGH SHEAR STELLARATOR. Vishnevetskii, V. N.; Volkov, E. D.; Dikii, A. G.; Zalkind, V. M.; Konotop, P. N.; Moiseev, S. S.; Pavlichenko, O. S.; Suprunenko, V. A.; Tolok, V. T. (Akademiya Nauk Ukrainskoi SSR, Kharkov. Fiziko-Tekhnicheskii Institut). Translated for Culham Lab., Abingdon, Eng., from report KHFTI-69-48. 22p. Dep. CFSTI (U. S. Sales Only).

The experiments were carried out under ohmic heating conditions, with a density of helium plasma $n_e = (2 \text{ to } 8) \times 10^{12}$ cm^{-3}. The following parameters were measured: the voltage at the stellarator circumference, the discharge current, the electron density, and the electron temperature. The main objects of the experiments was to throw light on the effect of the shear and the rotational transform on the behavior of the plasma. (M.O.W.)

26176 IONIZING SHOCKS INCIDENT UPON A TRANSVERSE MAGNETIC FIELD. Bout, Dmitri A.; Post, Richard S.; Presby, Herman (Columbia Univ., New York). Phys. Fluids; 13: 1399-1401(May 1970).

The interaction of an ionizing shock wave incident upon a transverse magnetic field was investigated. The interaction results in slowing the transmitted shock and forming a reflected one. The magnetic field is compressed by the shock and decreases behind the shock. (auth)

26177 CONVECTIVE LOSSES IN A THERMIONIC PLASMA WITH SHEAR. Mosher, David; Chen, Francis F. (Princeton Univ., N. J.). Phys. Fluids; 13: 1328-50(May 1970).

Experiments on anomalous transport in a Q machine with a hard core providing magnetic shear show shear-dependent particle losses in the absence of oscillations. It is demonstrated that these Bohm-like losses are caused by steady plasma convection in asymmetric electric fields produced by small temperature gradients in the end plates and that the effect of shear is to symmetrize the convective patterns by twisting the equipotentials into tight spirals. A finite-Larmor-radius theory of transport by convection is presented which correctly predicts the observed increase of confinement with shear. Estimates of the absolute magnitude of losses by this mechanism indicate that at least half of the anomalous transport in Q machines is due to plasma convection, at least in magnetic fields below 4 kG. (auth)

26178 PRESSURE DISTRIBUTION IN THE STRUCTURE OF A PROPAGATING CURRENT SHEET. York, Thomas M. (Pennsylvania State Univ., University Park); Jahn, Robert G. Phys. Fluids; 13: 1303-9(May 1970).

The structure of the current sheet in a dynamic z pinch in argon is studied with a specialized high-speed piezoelectric pressure transducer capable of following profiles of axial and radial pressure within the discharge. Correlation of these data with electric and magnetic field profiles, luminosity, and voltage records, indicates three distinct zones within the sheet in sequence, regions of electron current conduction, mass accumulation with ion current conduction, and induced flow of unswept gas. Profiles of particle density, velocity, and temperature are evaluated on the basis of a simplified gas-kinetic model. The current sheet is found to entrain a large percentage of the gas encountered, and a momentum balance across the sheet is in approximate agreement with snowplow predictions, but the distributions of current and mass density differ categorically from conventional piston-shock wave models. (auth)

26179 TURBULENCE IN THE POSITIVE COLUMN. Halseth, Martin W.; Pyle, Robert V. (Univ. of California, Berkeley). Phys. Fluids; 13: 1238-48(May 1970).

An oscillation that is helical in shape is known to be present when an axial magnetic field applied to the positive column of a glow discharge is greater than the critical magnetic field B_c for the onset of the current convective instability. According to a theory proposed by Kadomtsev, this oscillation will be replaced by a turbulent spectrum of oscillations when the field is several times B_c. In this experiment with a helium plasma the magnetic field was raised to as much as 20 times B_c to determine if and to what degree random oscillations characteristic of strong turbulence will replace the helical instability. It was found that strong turbulence dominated the positive column when the magnetic field was greater than 15 times the critical field. The radial mixing length as determined from spatial correlations with movable Langmuir probes and the radial density profile were found to agree with the results calculated from Kadomtsev's theory for strong turbulence. Particle transport rates calculated from the theories of Dupree and Kadomtsev for a turbulent plasma agree within a factor of 2 with the values deduced from this experiment. (auth)

26180 MAXIMUM LUMINESCENCE OF SPECTRAL LINES DURING PLASMA DECAY. Kruzhilin, N. A.; Yakubov, I. T. (Inst. of High Temperatures, Moscow). Teplofiz. Vys. Temp.; 7: 1010-12(Sep-Oct 1969). (In Russian).

The basic characteristics of plasma (electron concentration and temperature, distribution of excited atoms by their states, time dependence of spectral line intensities, and intensities of lines passing through the maximum) were investigated using decaying cesium plasma. The variations in concentration of excited atoms were studied within the limits of quasi-steady-state theory. It was concluded that the use of kinetics of excited-state populations responsible for the line-spectrum type of emission during plasma decay and increased ionization explain, in general, the maximum lines. (R.V.J.)

26181 EFFECT OF PRELIMINARY IONIZATION ON INCREASED CONDUCTIVITY OF ARGON PLASMA UNDER THE INFLUENCE OF PULSED ELECTRIC FIELDS. Vasil'eva, I. A.; Kosova, R. V. (Inst. of High Temperatures, Moscow). Teplofiz. Vys. Temp.; 7: 1008-10(Sep-Oct 1969). (In Russian).

The pulsed electric field modulated the induced channel field The experiments indicated that, in argon at 50-mm Hg pressure, the conductivity increased from 1 to 15 mho/cm in 10 to 40 μsec. The electric field inducing such increase did not exceed 8 V/cm. The processes of ionization development depend on the volume of preliminary ionized gas. Data obtained indicate that, in certain cases, inert gases without easily ionizing additions could be used as working material in nonequilibrium MHD generators. (R.V.J.)

26182 THERMAL FLUX IN ELECTRODES AND ELECTRODE EROSION IN QUASI-STATIONARY PLASMA ACCELERATORS. Dorodnov, A. M.; Ivashkin, A. B.; Kozlov, N. P.; Reshetnikov, N. N.; Chursin, M. M. (Moscow School of Tech.). Teplofiz. Vys. Temp.; 7: 951-8(Sep-Oct 1969). (In Russian).

Chemical methods were used for measuring the erosion of electrodes of various materials (Cu, Mo, and W) and the thermal flow into the central accelerator electrode. The characteristics of thermal flux distribution along the external electrode were analyzed in the current range from 3 to 15 kA at different electrode polarities. (R.V.J.)

26183 EXPERIMENTAL INVESTIGATIONS OF DIFFERENT TYPES OF LOSSES IN CONTACT-IONIZATION PLASMAS. Hashmi, M.; van der Houven van Oordt, A. J.; Wegrowe, J. -G. (Institut fuer Plasmaphysik GmbH, Garching, Ger.). pp 127-38 of International Conference on Physics of Quiescent Plasmas. Pt. II. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.2).

Particle losses much larger than given by the equilibrium theory were observed in the low-density range of thermally ionized magnetoplasmas. Furthermore, experiments also indicated an enhanced surface recombination rather than anomalous diffusion to be responsible for these losses. A series of results with Cs, Ba, Sr and Li plasmas are produced and compared with the theory which deals with enhanced surface recombination. It is found that the intrinsic loss processes are surface recombination, as described in the previous paper and classical diffusion. Additionally, enhanced losses across the magnetic field may occur. The conditions under which they appear are described. (auth)

26184 CONVECTIVE AND OSCILLATORY LOSSES IN Q MACHINES. Chen, Francis F. (Princeton Univ., N. J.). pp

159-71 of International Conference on Physics of Quiescent Plasmas. Pt. II. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.2).

Anomalous transport in Q machines is caused partially by dc convection and partially by oscillations. Pure drift waves can account for only a small radial loss because their amplitude is small at the boundary. Large nonlinear oscillations can cause a large loss by increasing the dc convection. Turbulent fluctuations can carry plasma across the boundary easily and also cause a large loss when the spectrum extends to low frequencies (not necessarily dc). An effort was made to confirm these conclusions by direct measurements of the radial flux by means of a plasma eater, but the data did not give self-consistent results. (M.O.W.)

26185 MEASUREMENT OF THE RESONANT CHARGE EXCHANGE CROSS SECTION IN A POTASSIUM Q MACHINE PLASMA COLUMN. Dreicer, Harry; Henderson, Dale B.; Mosher, David; Wittman, Frederick E.;Wolfsberg, Kurt (Los Alamos Scientific Lab., N. Mex.). pp 11-16 of International Conference on Physics of Quiescent Plasmas. Pt. III. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.3).

The Los Alamos Q-machine has been used to measure the resonant charge exchange cross-section σ_x of K^+ on K. An atomic beam tagged with radioactive K atoms (^{42}K) is directed across the nonradioactive plasma column. The undeviated beam is condensed on a cold collector; those beam atoms which charge exchange are trapped on magnetic field lines and are condensed on a second cold collector which terminates the plasma column. Radiochemical techniques are used to determine the number of ^{42}K atoms on each collector. A microwave cavity monitors the plasma density. These measurements yield a tentative value of 2 to 3×10^{-13} for σ_x with possibly a small contribution due to purely elastic scattering. (auth)

26186 QUIESCENT NEUTRALIZED BEAM PLASMA WITH VARIABLE T_i/T_e. Taylor, R. J.; Ikezi, H.; MacKenzie, K. R. (Univ. of California, Los Angeles). pp 57-66 of International Conference on Physics of Quiescent Plasmas. Pt. III. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.3).

A conventional argon discharge plasma is produced in a metal chamber approximately 30 cm long and 30 cm in diameter. Ions from this plasma are accelerated by a 30-cm-diameter negatively biased grid into another chamber of similar proportions. The large plane beam of ions is neutralized by a number of filaments spaced regularly around the circumference. The more or less monoenergetic beam of ions is spread in angle and energy by a high frequency signal on a second grid placed just after the accelerating grid. By properly adjusting the high-frequency voltage and filament potential a very good approximation to a half-Maxwellian is obtained. The mean ion energy depends on the initial energy of the accelerated ions, while the electron temperature depends on the filament temperature and potential. In this way, a very useful large-volume quiescent plasma with ions hotter than electrons and a variable T_i/T_e ratio can be produced. (auth)

Kinetics (Theoretical)

Refer also to abstract 26345.

26187 (AD-697947) TRANSIENTS IN ELECTRON PLASMAS. Derfler, Heinrich; Simonen, T. C. (Stanford Univ., Calif. Inst. for Plasma Research). Aug 1965. Contract AF33(615)-1504. 16p. (SU-IPR-28). CFSTI.

It is shown that evanescent Bohm and Gross waves and Van Kampen modes are both aspects of one and the same analytic wave function and, thus, really do not exist independently. This new function is subject to the Fried and Conte dispersion relation, casual in nature, and rigorously describes electrostatic events in plasmas. In fact it was found possible to solve the age-old problem of constructing the Green's function from these waves. By means of this Green's function the signal propagating through the plasma due to any other mode of excitation can be obtained by simple convolution. (auth) (USGRDR)

26188 (AD-698330) ANALYTICAL TREATMENT OF RADIATION AND CONDUCTION LOSSES IN THERMAL INDUCTION PLASMAS. Research Report, June 1968-January 1969. Eckert, Hans U. (Aerospace Corp., El Segundo, Calif.). 7 Nov 1969. Contract F04701-69-C-0066. 44p. (TR-66(5220)-50; SAMSO-TR-69-386). CFSTI.

Approximate solutions were obtained of the Elenbaas-Heller equation for a two-zone model of thermal induction plasmas. In this model, most of the heat production takes place in an external zone where it is balanced by heat conduction, radiation losses being negligible in this region. Most of the heat so generated is conducted to the walls, but a small fraction of it is conducted inward and forms the principal heat source for the second, internal, zone. Radiation is the dominant loss mechanism in this inner region. Under these conditions, the distribution of the heat conduction potential assumes a parabolic shape for the inner zone, whereas it is described by Bessel functions in the external zone. A coordinate transformation in this zone accounts for the nonuniformity of the induced electric field and explicitly shows the effect of skin depth upon the profile shape. Matching of the zonewise solutions yields temperature distributions that are continuous to the first derivative and display the characteristic minimum at the axis known from experimental work. Generalized charts are presented by which a particular profile can be calculated from the gas transport properties and the time rate of change of primary magnetic flux. (auth) (USGRDR)

26189 (AD-699957) DOUBLE LAPLACE TRANSFORMATION IN MIXED BOUNDARY-INITIAL VALUE PROBLEMS AND ITS APPLICATION TO MULTI-COMPONENT PLASMAS. Evans, Kenneth Edward Jr. (Illinois Univ., Urbana. Coordinated Science Lab.). Dec 1969. Contract DAAB07-67-C-0199. 93p. (R-450). CFSTI.

The application of the double Laplace transform (Laplace transformation in both space and time) to the solution of systems of linear, homogenous, hyperbolic, partial differential equations with real, constant coefficients is treated. The purpose of this treatment is to discuss comprehensively a method whereby the mixed-boundary initial-value problem for these equations can be solved. The treatment is limited to one-dimensional systems. Certain features of the double Laplace transform method that appear in the solution of equations of the type described are examined in detail. Two of these features are the important role played by the characteristics of the partial differential equations and the restrictions among the boundary and initial conditions which are necessary for a well-defined solution. The method is applied to the moment equations for a multicomponent plasma, and the connection between the general solution and the usual 'normal mode' solution is discussed. The case of a monoenergetic beam injected into a cold, semi-infinite plasma is treated in detail. The effect of the collisions of the plasma particles with the background is included. A solution for the growth of an initial thermal disturbance in the plasma is obtained. This treatment yields the first picture of the relationship between the temporal and spatial growth in a finite, unstable plasma. (auth) (USGRDR)

26190 (N-70-13092) CRITICAL ANALYSIS OF THE GRAD APPROXIMATION FOR CLOSING OUT THE MAGNETOHYDRODYNAMIC EQUATIONS FOR PLASMAS. Meador, Willard E. (National Aeronautics and Space Administration, Langley Station, Va. Langley Research Center). Dec 1969. 38p. (NASA-TR-R-325; L-6523). CFSTI.

The use of Grad's 13-moment distribution functions in closing out the generalized MHD equations for plasmas is critically analyzed. In particular, the inaccurate particle velocity dependence of the Grad approximation is shown to yield significant errors in the collisional transfers of such quantities as momentum and energy as functions of the moments (variables of the problem) considered. These errors directly affect the relations between moments derived by means of the aforementioned closing-out process; consequently, when the Grad functions are written so as to incorporate the moment relations, considerable doubt is cast upon the ability of such functions not only to describe the original 13 moments but also to predict accurately other plasma properties as well. Numerous comparisons with the exact first- and second-order perturbation solutions of the Boltzmann equation are made in order to substantiate these conclusions. The convergence of Grad-type functions as more moments are added, in consequence of which at least 16 moments are often necessary, is also studied. (auth) (STAR)

26191 (N-70-13357) LAMINAR SHOCKS AND OTHER NONLINEAR WAVES IN WARM PLASMAS. Crevier, William F. (Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics). Nov 1969. 136p. (NASA-CR-107211; TN-BN-626). CFSTI.
Thesis.

A two-fluid model for collisionless shock waves in warm plasmas is presented. Dissipation is included by assuming an effective collision frequency. The model is capable of describing waves over a wide range of Mach numbers and angles of propagation. The wave behavior is compared to the motion of a particle moving in a somewhat complicated force field. A part of this force can be written as the gradient of a potential. By studying the shape of the potential for various initial conditions, general conclusions about the wave behavior can be made. The potential-well analogy is complicated by the fact that friction heats the plasma and alters the shape of the potential well. The response of the plasma to a small perturbation is analyzed by linearizing the equations of motion about their equilibrium values. Comparing the shape of the potential well near the origin with the results of the linearized equations of motion provides considerable physical insight into the initial-wave behavior. (auth) (STAR)

26192 (N–70–13474) THIRD-ORDER CONTRIBUTIONS TO ELECTRICAL CONDUCTION IN PLASMAS. Meador, Willard E. (National Aeronautics and Space Administration, Langley Station, Va. Langley Research Center). Dec 1969. 19p. (NASA-TN-D-5477). CFSTI.

The electrical conductivity is calculated for a highly nonequilibrium plasma corresponding to the application of an electric field varying linearly with time. Two methods are employed: (1) the direct approach consisting of an exact solution to a modification of the third-order kinetic equation of Chapman and Enskog, and (2) Everett's technique for closing out the macroscopic equations of change with the Grad 13-moment velocity distribution function. Comparisons between the two sets of results indicate substantial third-order differences for most interparticle interaction potentials of practical interest; hence, the Grad 13-moment approximation does not appear to describe adequately certain higher order contributions to plasma transport coefficients. (auth) (STAR)

26193 CORRELATIONS IN PLASMA. I. Dasgupta, Brahmananda; Dasgupta, Padmanabha (Saha Inst. of Nuclear Physics, Calcutta). J. Math. Phys. (N. Y.); 11: 603-9(Feb 1970).

The correlations of fluctuation in electric-field intensity and current density are derived for nonequilibrium isotropic plasma. The calculation is based on the ring-approximation results of Balescu and Taylor. The results reduce to the results obtained by Rostoker in the special case when the velocity-distribution function is Maxwellian at the initial time. (auth)

26194 COLLECTIVE EFFECTS ON THE PROFILES OF SPECTRAL LINES BROADENED BY ELECTRONS AND IONS IN A PLASMA. Griem, Hans R. Comments At. Mol. Phys.; 1: 145-9(Dec 1969–Jan 1970).

A brief theoretical discussion is given on the spectral line broadening from plasma due to particle collisions. Expressions for spectral line profiles are given. (M.O.W.)

26195 STUDY OF AN IONIZING SHOCK WAVE IN A TRANSVERSE MAGNETIC FIELD. Kasahara, Eiji; Miida, Yoshiro (Keio Univ., Tokyo). Trans. Jap. Soc. Aeronaut. Space Sci.; 12: No. 20, 1-7(Oct 1969).

The behavior of an ionizing shock wave in a magnetic field is considered. Making use of magnetohydrodynamics, it is found that the ionizing shock wave that propagates into a transverse magnetic field is partially reflected at the entrance of the magnetic field. This relation is derived by applying the shock reflection theory, which is related with the theory of the ionizing shock wave propagating in a transverse magnetic field. When a shock wave propagates in nonionized argon gas, the relation of this shock reflection is calculated with the consideration of ionizing phenomena, assuming that the gas behind a shock wave reaches thermal equilibrium immediately. (NSA of Japan)

26196 THETA PINCH BEHAVIOR FOR VERY EARLY TIMES. Miller, Bennett (Columbia Univ., New York). Phys. Fluids; 13: 1412-14(May 1970).

A two-dimensional model of a theta pinch is used to analyze the buildup of the drive current on the surface of the plasma. The analysis shows that the usual asymmetric method of feeding energy into the plasma can produce significant azimuthal asymmetries in the current distribution. (auth)

26197 DRIFT VELOCITIES IN A TIME-DEPENDENT ELECTRIC FIELD. Gelman, Harry (MITRE Corp., Bedford, Mass.). Phys. Fluids; 13: 1403-5(May 1970).

Generalized expressions are derived for the Hall, polarization, and Pedersen drift velocities, which are valid in a static magnetic field and an electric field with arbitrary time dependence. (auth)

26198 THERMAL RELAXATION IN ONE- AND TWO-DIMENSIONAL PLASMA MODELS. Montgomery, David; Nielson, C. W. (Los Alamos Scientific Lab., N. Mex.). Phys. Fluids; 13: 1405-7(May 1970).

Thermal relaxation of stable one- and two-dimensional plasmas is followed in time by particle-in-cell numerical computation. The predicted dependences of relaxation rate on plasma parameter are observed. (auth)

26199 COMPARISON OF THREE SETS OF HIGHER ORDER ADIABATIC PLASMA EQUATIONS. Wilson, Gerald E. (Goddard Space Flight Center, Greenbelt, Md.). Phys. Fluids; 13: 1372-9(May 1970).

A comparison is made among three methods of obtaining highly accurate approximate expressions for the average motion of plasmas in slowly varying electric and magnetic fields. It is shown that no inconsistencies are revealed by this comparison and that, in fact, two of the techniques are completely equivalent while most of the results of the third can be obtained from the equivalent pair. As a by-product of the comparison, a function is obtained which can be shown to be conserved along the guiding-center trajectory. (auth)

26200 LOW-DENSITY PLASMA SHEATH IN THE PRESENCE OF A WEAK MAGNETIC FIELD. Caron, Paul R. (Electronics Research Center, Cambridge, Mass.). Phys. Fluids; 13: 1298-302(May 1970).

The theory of the collisionless plasma sheath with a weak magnetic field is presented. Both planar and cylindrical geometries are considered. Two forms for the ion–electron pair generation function are considered— a constant function and a function proportional to electron density. These are applicable to beam-generated plasmas and to positive columns. Numerical results are given for the plasma limit when the generation function is constant. (auth)

26201 TRANSVERSE RESISTIVE SHOCK WAVES. Coffey, T. P. (Edgerton, Germeshausen, and Grier Inc., Arlington, Va.). Phys. Fluids; 13: 1249-58(May 1970).

The existence and structure of transverse resistive shock waves is discussed within the framework of the two-fluid theory. The analysis incorporates the effects of electron inertia, finite pressure, charge separation, and electrical resistivity. Critical Mach numbers above which resistive shock waves cannot exist are obtained as functions of the fluid-to-magnetic pressure ratio. These critical Mach numbers are not related to the critical Mach numbers obtained in the cold plasma theory. It is shown that the wavelength of the downstream oscillations can be considerably different from that predicted by cold plasma theory, especially in the vicinity of the critical Mach number. Where possible, comparison is made with the results obtained from cold plasma theory. (auth)

26202 TEST PARTICLE METHOD IN KINETIC THEORY OF A PLASMA. Matsuda, Kyoko (Goddard Space Flight Center, Greenbelt, Md.). Phys. Fluids; 13: 1217-22(May 1970).

A general relationship was found between many-body correlation functions and the conditional probability functions that describe the shield clouds surrounding test particles. This is the generalization of Rostoker's superposition principle. The relationship is useful because the problem of kinetic theory is reduced to determining the conditional probability functions, which essentially involves only the Vlasov equation. (auth)

26203 ION CORRELATIONS DUE TO A HIGH-FREQUENCY ELECTRIC FIELD AND THEIR EFFECT ON THE NONLINEAR PLASMA CONDUCTIVITY. Sanmartin, Juan R. (Princeton Univ., N. J.). Phys. Fluids; 13: 1223-9(May 1970).

The influence of a strong, high-frequency electric field on the ion–ion correlations in a fully ionized plasma is investigated in the limit of infinite ion mass, starting with the Bogoliubov–Born–Green–Kirkwood–Yvon hierarchy of equations; a significant departure from the thermal correlations is found. It is shown that the above effect may substantially modify earlier results on the nonlinear high-frequency plasma conductivity. (auth)

26204 ELECTRON DISTRIBUTION AND TRANSPORT PHENOMENA IN A LORENTZIAN MAGNETOPLASMA. Buti, B. (Indian Inst. of Tech., New Delhi). Phys. Fluids; 13: 1209-11(May 1970).

The electron distribution functions, required for the evaluation of the transport coefficients in a homogeneous Lorentzian plasma, are derived in the presence of a uniform external magnetic field which is strong enough to affect the interparticle collisions but still small enough for ω_c/ω_p (ω_c and ω_p being the electron cyclotron and plasma frequencies) to be used as an expansion parameter. The coefficients of electrical conductivity, thermal diffusion, and viscosity are determined through these functions. The effect of magnetic field, through collisions, up to second order in (ω_c/ω_p) vanishes identically for conductivity and diffusion; for viscosity although it does not vanish, it is negligibly small. (auth)

26205 MONTE-CARLO METHOD FOR CALCULATING PROPERTIES OF PARTIALLY IONIZED HYDROGEN. Samuilov, E. V.; Shevelev, V. P. Teplofiz. Vys. Temp.; 7: 817-21(Sep-Oct 1969). (In Russian).

Monte Carlo methods were used for calculating the statistical sum of a canonical ensemble of a given number of electrons, protons and hydrogen atoms. The sum was expressed as an integral with a subintegral function presented as a product of the quantum statistical sum of all atoms depending on the configuration of the system and exponential function of the sum of the kinetic energy of protons and electrons, and the potential energy of interaction of all particles of the system. The integral was calculated for the phase space corresponding to the proton and electron, in a free state. (tr-auth)

26206 POSSIBILITY OF EXISTENCE OF SUPERCOOLED DENSE PLASMA. Biberman, L. M.; Norman, G. E. (Inst. of High Temperatures, Moscow). Teplofiz. Vys. Temp.; 7: 822-31(Sep-Oct 1969). (In Russian).

A three-component plasma model (atoms, electrons, and positive ions) was used in order to study isotherms of a real plasma in a region in which plasma becomes strongly imperfect due to the free-charge interactions. A possible shape of the metastable isotherm area was demonstrated, and the role of imperfect atoms and their superposition over electron shells are discussed, as well as the possibility of existence of isolated area of metastable states. Dispersion relations for metastable state parameters were formulated, and plasma states in which the dispersions hold are shown. The example of metastable air plasma at normal temperature is analyzed. The hypothesis of ball lightning as such a state of air is discussed. (tr-auth)

26207 NUMERICAL STUDIES OF A NONLINEAR EFFECT IN PLASMA. Bednarz, R. J.; Makosa, D. (Inst. of Nuclear Research, Swierk, Poland). pp 159-66 of International Conference on Physics of Quiescent Plasmas. Pt. I. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.1).

A differential equation is numerically solved for the Maxwellian distribution of electrons with a small "bump" in the Maxwellian tail. The analysis centers on equations from an earlier paper (W. E. Drummonds and D. Pines, Nuclear Fusion Suppl., Part 2, 1049-1057(1962)). (M.O.W.)

26208 DEVELOPMENT OF COLLISIONAL-DRIFT-WAVE TURBULENCE. Hendel, H. W.; Chu, T. K. (Princeton Univ., N. J.). pp 27-32 of International Conference on Physics of Quiescent Plasmas. Pt. II. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.2).

An observation was made of the step-by-step transition from a quiescent to a turbulent plasma. Turbulence was achieved by increasing a Reynolds' number ($\propto B$, the magnetic field), defined with the diamagnetic velocity, a stream length and the ion fluid viscosity, to a value far beyond the onset value. The data are described. (M.O.W.)

26209 PERIODIC PULLING AND THE TRANSITION OF TURBULENCE IN A Q MACHINE. Abrams, R. H. Jr.; Yadlowsky, E. J.; Lashinsky, H. (Univ. of Maryland, College Park). pp 73-80 of International Conference on Physics of Quiescent Plasmas. Pt. II. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.2).

A nonlinear mechanism called periodic pulling is described that can vary the amplitude and frequency of the modes in such a way as to provide the transition from the discrete-mode spectrum to the low-level turbulence spectrum. This mechanism is essentially the incomplete locking of a mode by a perturbation whose frequency and amplitude are just beyond the values corresponding to mode locking. The physical origin of such perturbations is discussed. (M.O.W.)

26210 COLLISION-INDUCED AMPLIFICATION EFFECTS IN A SLIGHTLY IONIZED PLASMA. Crescentini, A. A.; Maroli, C. (CNR, Milan. Univ., Milan). pp 91-8 of International Conference on Physics of Quiescent Plasmas. Pt. II. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.2).

A summary is given of an earlier paper (O. De Barbieri and C. Mardi: J. Plasma Phys. 1, 473(1967)) on a quasi-linear theory for the interaction of a slightly ionized plasma with a single-mode electromagnetic field. (M.O.W.)

26211 SURFACE RECOMBINATION IN CONTACT-IONIZATION PLASMAS. Hashmi, M.; van der Houven van Oordt, A. J.; Wegrowe, J. -G. (Institut fuer Plasmaphysik GmbH, Garching, Ger.). pp 139-49 of International Conference on Physics of Quiescent Plasmas. Pt. II. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.2).

A theoretical explanation of the discrepancy between "equilibrium" theory and experimental results in the electron sheath region of a contact ionization plasma is given. After the treatment of the collisionless case, which implies the assumption of a non-Maxwellian velocity distribution and consequently, enhanced surface recombination on the hot endplates, the influence of collisions, particularly in "double-ended operation," is discussed. It is shown that the relation density n vs incoming neutral flux J_0 depends strongly on the degree of thermalization caused by these collisions. For a contact ionization plasma in a Q device, this degree of thermalization, given by $p' = n_2$ (thermalized particles)/n_1 (nonthermalized particles) is expected to be of the order of 1, which yields a linear relation between J_0 and n. For the ion-sheath region it is shown that even rare collisions will lead to complete thermalization of the plasma, i.e., the "equilibrium" theory should be valid. (auth)

26212 THEORY OF VELOCITY DISTRIBUTIONS ASSOCIATED WITH BOUNDED QUIESCENT PLASMAS: A PROBLEM IN SPATIAL RELAXATION. Dreicer, H.; Thomas, J. D.; Riesenfeld, W. B. (Los Alamos Scientific Lab., N. Mex.). pp 1-10 of International Conference on Physics of Quiescent Plasmas. Pt. III. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.3).

The problem of determining the various plasma velocity distribution functions in the region between boundaries upon which they are specified involves the simultaneous solution of the Poisson equation and of the time independent electron and ion Fokker–Planck equations with space derivatives retained. The latter take the form $\vec{v}\cdot(\partial f/\partial \vec{x}) = (\partial f/\partial t)_{\text{collision}}$ and since they have not previously been solved for Coulomb forces they represent the most formidable barrier to an understanding of the problem. This study addressed itself to this point by considering the solution of the time-independent Fokker–Planck boundary-value problem for the case of plane parallel boundaries, which most closely approximates the situation in double- and single-ended Q-machines. When electron–ion encounters alone are considered, and space charge electric fields are ignored, the problem reduces to a linear eigenvalue problem whose numerically computed eigenvalues and eigenfunctions (their completeness has not yet been proved) were described earlier. The computational complexity introduced by the specification of partial boundary conditions on two boundaries was overcome and numerical solutions are obtained in the form of contours of constant distribution function for each point in real space between the boundaries. The solutions obtained appear to provide the first examples of solutions to a spatial relaxation problem in plasma physics. (auth)

26213 EVOLUTION OF MICROSCOPIC CHARACTERISTICS OF A CESIUM VAPOR DURING POST-LUMINESCENCE. Jeannet, J. C.; Ronssin, S.; Sayer, B. (CEN de Saclay, Gif-sur-Yvette, France). pp 27-33 of International Conference on Physics of Quiescent Plasmas. Pt. III. Paris; Ecole Polytechnique (1969). (In French).
See CONF-690923(Pt.3).

The first results of the study of postluminesence at a pressure of 0.15 torr are presented. It is found that under the conditions of these experiments the evolution of microscopic parameters, density and temperature of electrons, and the population of excited levels of a postluminescence in ionized cesium vapor can be interpreted by a collisional–radiative recombination theory. The recombination coefficients determined at 0.15 torr confirm some previous results, but are in disagreement with coefficients above 10^{-8} cm^3/s. (J.F.P.)

Production

26214 (LA-tr-70-6) LASER-PLASMA PRODUCTION SYSTEM FROM A SINGLE SOLIDIFIED GAS PARTICLE. Sekiguchi, Tadashi; Hirosawa, Haruto; Tanimoto, Mitsumori; Kitsunezaki, Akio. Translated for Los Alamos Scientific Lab., N. Mex., from Tokyo Daigaku Kogakubu Kiyo, A; No. 6, 36-7(1968). 6p. Dep. CFSTI.

Any kind of gas except helium (particularly Xe and H in these experiments) is frozen into a solid column, 0.4 mm in diameter and about 0.7-mm long, which is moved in a vacuum chamber by a thin pipe and remains hanging down. The column is reshaped into a desired size at its root as a result of gradual evaporation, and is then cut by a low-power laser pulse thermally or by a thin blade mechanically. The light signal scattered from the falling column triggers a Q-switched laser ($\gtrsim$100 MW). The laser light pulse is focused on a particle isolated at the center of a vacuum chamber to produce high-temperature and high-density plasma. Plasmas produced by such a unique method will offer most appropriate means to study the interaction mechanism between hot, dense plasmas and magnetic field configurations of any type. (auth)

26215 A METHOD OF OBTAINING HIGH PLASMA TEMPERATURES USING PULSED CONSTRICTED ARCS. Morris, J. C.; Morris, R. U. (Avco, Wilmington, Mass.). Rev. Sci. Instrum.; 41: 661-6(May 1970).

A simple method of pulsing constricted electric arcs to high power inputs is described. Using this method, peak power inputs six times greater than can be run continuously have been achieved. An analysis of this method was made for argon to determine the maximum temperature to be expected as a function of arc channel diameter and generator construction material. In addition, a number of methods used for electric and spectroscopic diagnostic studies of the pulsed high-current arc column are discussed. (auth)

26216 STUDIES OF DENSE PLASMA PULSED ARCS AT HIGH PRESSURE. I. EMISSION OF PULSED ARCS. Mitin, R. V.; Kantsedal, V. P. (Physical-Technical Inst., Kharkov). Teplofiz. Vys. Temp.; 7: 846-51(Sep-Oct 1969). (In Russian).

Emission of dense plasma formed in pulsed arcs in argon at 1 to 80 atm pressure and up to 100 kA with pulse duration ~0.6 msec was studied. The discharges were initiated by aluminum and copper wires 6 cm long and 0.3 mm in diameter. The arc emission reached a maximum at the pressure of 30 to 40 atm, at which the luminescent temperature of the arc surface changed from 1.3×10^4 to 3.5×10^4 °K depending on the current. Time integral spectra were obtained as function of gas pressure current in the arc, and material of the initiating wire. (tr-auth)

26217 CYLINDRICAL BLAST WAVE PROPAGATING IN A CONDUCTING GAS. Verma, B. G. (Univ. of Gorakhpur, India). Z. Angew. Math. Phys.; 21: 119-24(25 Jan 1970).

The two-dimensional propagation of a cylindrical blast wave in a conducting plasma subjected to a magnetic field is studied. A sudden explosion is assumed to take place along a straight line of infinite extent in a perfectly conducting gas, otherwise at rest, which is thrown into motion symmetrically all around the straight line. The disturbance is bounded on the outside by a cylindrical shock wave that propagates radially outward into the quiescent gas. Viscosity and heat conduction are not taken into account, and it is assumed that the flow is isentropic along a streamline. (M.H.R.)

26218 NONRESONANT RADIOFREQUENCY SOURCE OF HIGH-DENSITY QUIESCENT PLASMA. Lisitano, G. (Institut fuer Plasmaphysik, Garching, Ger.); Fontanesi, M.; Sindoni, E. pp 35-8 of International Conference on Physics of Quiescent Plasmas. Pt. III. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.3).

The nonresonant absorption of rf power was studied in a newly designed slow wave structure. The plasma density was recorded as a function of the applied rf power for a constant magnetic field strength corresponding to $\omega_b/\omega_{rf} \approx 3$ in the coil region. (M.O.W.)

26219 QUIESCENT PHOTOIONIZED PLASMAS. DeGroot, J. S.; Cohn, D.; Robin, J.; MacKenzie, K. R. (Univ. of California, Los Angeles). pp 49-56 of International Conference on Physics of Quiescent Plasmas. Pt. III. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.3).

The use of photons for producing quiescent plasmas is discussed. The following topics are briefly discussed: photon sources, the square law dependence, diagnostics, nature of the quiescence, and experiments. (M.O.W.)

26220 PRODUCTION AND STUDY OF AN ALKALI PLASMA WITH NEGATIVE IONS. Hashmi, M.; van der Houven van Oordt, A. J.; Wegrowe, J. -G. (Institut fuer Plasmaphysik GmbH, Garching, Ger.). pp 67-72 of International Conference on Physics of Quiescent Plasmas. Pt. III. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.3).

The method of contact ionization was used to produce a three-component plasma (Cs^+, Cl^-, e^-) in the Q device BARBARA using a beam of cesium chloride. The end-plate temperature controls the concentration of Cl^-, which can be varied in a wide range. The density of negative ions is obtained from the difference between the positive ion density given by a Langmuir probe and the electron density given by a microwave resonator. Some properties of the plasma are presented. (auth)

26221 VACUUM FURNACES FOR ISOTHERMAL PLASMA. Rosatelli, C. (CNEN, Bologna). pp 95-102 of International Conference on Physics of Quiescent Plasmas. Pt. III. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.3).

An apparatus is described that was designed mainly for plasma diagnostics by microwave techniques. The plasma density profile at the boundaries can be measured. Operation of the device is described. (M.O.W.)

Stability

Refer also to abstracts 26208 and 26285.

26222 (AD-697949) GROWING WAVE AND INSTABILITY CRITERIA FOR HOT PLASMAS. Derfler, Heinrich (Stanford Univ., Calif. Inst. for Plasma Research). 1967. Contract F33615-67-C-1284. 5p. (SU-IPR-153). CFSTI.

In the original colliding-pole criterion for determining instability types from dispersion relations, the Landau poles had to be selected laboriously. The simple rule is proved that only poles colliding through negative wave number lead to nonconvective instability. (auth) (USGRDR)

26223 (AD-698810) FEEDBACK STABILIZATION OF HIGHLY CONDUCTING PLASMAS. Wang, P. K. C. (California Univ., Los Angeles. School of Engineering and Applied Science). 15 Dec 1969. 7p. (AFOSR-69-3119-TR). CFSTI.

A general result for the feedback stabilization of surface instabilities of a highly conducting plasma is presented. Explicit form of feedback for stabilizing a linear pinch with a uniform axial magnetic field is given. (auth) (USGRDR)

26224 FLUCTUATION LEVELS CONNECTED WITH REACTIVE MARGINAL INSTABILITIES OF A MAGNETIZED PLASMA. Minardi, E. (EURATOM-FOM, Jutphaas, Netherlands). Phys. Lett.; 31A: 459-60(20 Apr 1970).

Some physical aspects and applications are discussed of an expression giving the probability distribution for special collective resonant electrostatic fluctuations. The latter should include the marginal reactive instabilities associated with bodily energy transportation from the polarized plasma into the collective field. (auth)

26225 MAGNETOSTATIC EQUILIBRIUM. Miyajima, Shigeki (Nagoya Univ., Japan). Kakuyugo Kenkyu; 24: 313-18(Feb 1970). (In Japanese).

As was pointed out by A. Simon, a set of equations governing the well-known magnetostatic equilibrium does not yield a unique solution. The problem may be solved by making use of the following London equation, $j = e^2(1/m_e + 1/m_i)nA$, where j is the current density, m_e the mass of electron, m_i the mass of ion, n the electron number density, and A the vector potential. (auth)

26226 SUPPRESSION OF TWO-STREAM INSTABILITY BY BEAM MODULATION. Nakamura, Yoshiharu (Tokyo Univ. of Education). J. Phys. Soc. Jap.; 28: 1315-21(May 1970).

Standing waves of longitudinal electron oscillation were observed in a beam–plasma system. By applying a density modulation to the beam, the amplitude of oscillation decreased to zero when the modulation frequency was near to that of the spontaneous oscillation. The modulation depth necessary for the oscillation to vanish was nearly proportional to the difference between the oscillation frequency and the modulation one. When the oscillation was suppressed, the oscillation having the same frequency as the modulation one was excited. This suppression and synchronization can be well explained by the assumption that the oscillation of electron density is described by the Van der Pol equation. Under this self-oscillator model the linear growth rate is evaluated and compared with the value calculated from the dispersion equation of the two-stream instability. (auth)

26227 ORDINARY-MODE ELECTROMAGNETIC INSTABILITY IN HIGH-β PLASMAS. Davidson, R. C.; Wu, C. S. (Univ. of Maryland, College Park). Phys. Fluids; 13: 1407-9(May 1970).

An absolute instability associated with electromagnetic waves propagating perpendicular to an external magnetic field is discussed. A lower bound on the growth rate is found and it is shown that growth rates may be of the order of the electron cyclotron frequency. (auth)

26228 NONLINEAR DYNAMICS OF A SINGLE NONHARMONIC LOSS-CONE FLUTE MODE. Bodner, S. E. (Univ. of California, Livermore). Phys. Fluids; 13: 1409-11(May 1970).

Previous analysis at the cyclotron harmonics indicated that particles would move in closed isolated eddies with a maximum change in $kv_\perp/\Omega$ of π. At other frequencies a degeneracy is removed and some of the particles become untrapped. (auth)

26229 STABLE STATE OF RAREFIED PLASMA IN A Q MACHINE. Gurevich, A. V.; Salimov, R. A.; Buchel'nikova, N. S. (Inst. of Nuclear Physics, Novosibirsk, USSR). Teplofiz. Vys. Temp.; 7: 852-9(Sep-Oct 1969). (In Russian).

Stability of thermally ionized plasma in a Q machine was studied in the case in which the plasma potential was negative. Electron and ion distribution functions were found. Expressions were obtained for plasma potential, floating electrode potential, and volt-ampere characteristics. Data obtained were compared with experimental data. (tr-auth)

26230 EFFECT OF NONUNIFORM ELECTRIC FIELDS ON DRIFT INSTABILITIES. Dobrowolny, M. (EURATOM-CNEN, Frascati, Italy). pp 11-18 of International Conference on Physics of Quiescent Plasmas. Pt. II. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.2).

An equation is derived that describes drift instabilities in a low-β plasma in the presence of nonuniform electric fields perpendicular to the magnetic field, both in collisionless and collisional regimes. This equation is discussed and the influence of the electric field is studied in the framework of a local approximation. (M.O.W.)

26231 FEEDBACK STABILIZATION OF COLLISIONAL DRIFT WAVES BY MODULATED PARALLEL-ELECTRON-CURRENT SINK. Simonen, T. C.; Chu, T. K.; Hendel, H. W. (Princeton Univ., N. J.). pp 33-40 of International Conference on Physics of Quiescent Plasmas. Pt. II. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.2).

The experiment was performed in the oscillatory regime near instability onset where the growth rate, and hence instability amplitude, can be varied so that feedback effects may be studied in both stable and unstable plasmas. The instability amplitude and frequency for different growth rates are measured, both as a function of the feedback phase shift and gain. The measurements are described. (M.O.W.)

26232 DRIFT INSTABILITIES IN A COLLISIONLESS PLASMA WITH MAGNETIC SHEAR. Stott, P. E.; Little, P. F.; Burt, J. (Culham Lab., Abingdon, Eng.). pp 41-8 of International Conference on Physics of Quiescent Plasmas. Pt. II. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.2).

Plasma oscillations that possess the characteristics expected of the collisionless drift wave in a region of plasma were observed, where the density gradient is the only important mechanism available to drive any instability. The experiment is described along with the results. (M.O.W.)

26233 SOFT- AND HARD-ONSET AND AMPLITUDE SATURATION OF COLLISIONAL DRIFT INSTABILITIES. Chu, T. K.; Hendel, H. W.; Schlitt, L. G.; Simonen, T. C.; Stik, T. H. (Princeton Univ., N. J.). pp 57-64 of International Conference on Physics of Quiescent Plasmas. Pt. II. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.2).

Measurements are reported on the onset of lower azimuthal modes and of the amplitude behavior for the collisional drift instability in Q-machine alkali-metal plasmas, together with an interpretation based on mode-coupled Landau-type master equations. (M.O.W.)

26234 FEEDBACK STABILIZATION AND MODE COUPLING OF IONIZATION WAVES. Garscadden, A.; Bletzinger, P. (Aerospace Research Labs., Wright-Patterson AFB, Ohio). pp 99-105 of International Conference on Physics of Quiescent Plasmas. Pt. II. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.2).

Experimental results were obtained demonstrating stabilization and the opportunity to observe directly any mode changes from the interaction of individual waves when an external frequency was superimposed on the instability. These results are compared with theory since the dispersion relation of the waves can be measured experimentally and it is known theoretically to be a fair approximation. The results are discussed. (M.O.W.)

Thermonuclear Processes

26235 SOME FIELD PARAMETERS OF THE LINEAR HELIOTRON P FIELD. Uo, Koji (Kyoto Univ.). Kakuyugo Kenkyu; 24: 319-36(Feb 1970). (In Japanese).

The Heliotron P field can be produced by superposing the uniform axial field on the field of the current-carrying ring conductor series placed along the axis with regular intervals, and it is an interesting magnetic field for plasma confinement. It is essentially the same field as produced by putting the negative coil of the Heliotron B field inside the vacuum vessel, and is a sort of a chain of the Spherator field. Changing the values of the ratio of the ring field intensity to the uniform field and the ratio of the ring radius to the interval gives various kinds of interesting fields. Exact expressions are derived of the magnetic inductions and the lines of force of this field, and by expanding the complete elliptic integrals, field parameters that determine these various field configurations are obtained. (auth)

26236 $l = 2$ MAGNETIC SYSTEM WITH LARGE ROTATIONAL TRANSFORM AND LARGE SHEAR. Mohri, Akihiro (Kyoto Univ.). Kakuyugo Kenkyu; 24: 241-51(Jan 1970). (In Japanese).

Magnetic field systems with $l = 2$ helical windings, the pitch of which is fairly short, have large rotational transform and high shear. This high shear promises the formation of an average magnetic well, when a vertical field is externally applied. Numerical computations are presented to show that these properties are realized in practice. (auth)

26237 ARC SOURCE FOR SPECTROSCOPIC MEASUREMENTS OF ISOTHERMAL PLASMA SAMPLES AT VARIOUS PRESSURES. Klein, Lothar (Greyrad Corp., Princeton, N. J.). Rev. Sci. Instrum.; 41: 668-72(May 1970).

A wall-stabilized arc is described that incorporates new design features in order to increase the versatility of this source for quantitative spectroscopic measurements, extending its useful range to lower pressures and to the study of molecular gases. Spectral measurements of different arc portions can be made radially and compared with measurements along the arc axis. It was thus established that in end-on measurements of argon arcs an essentially homogeneous plasma is viewed by the spectrometer. (auth)

26238 METHOD AND APPARATUS FOR PRODUCING NUCLEAR FUSION. Dow, William G.; Rozian, Irving W. (to Consumers Power Co.). U. S. Patent 3,501,376. 17 Mar 1970. Filed 21 Jul 1967.

A method and apparatus for the generation of largely rotational kinetic energies of high magnitude in a slowly drifting stream of electrically charged particles of one polarity are described. The dc space-charge forces are neutralized by the combined action of crossed dc electric and magnetic fields. This high-kinetic-energy stream, a monopolar neutralized plasma, when using ion particles may be used in producing nuclear fusion, or when using electrons, may be used for electronic purposes. (auth)

26239 ROTATING CATHODE SYSTEM FOR Q MACHINE ENDPLATE HEATING. Guilino, E.; Mueller, P.; Sahner, K.; Trambauer, K. (Institut fuer Plasmaphysik GmbH, Garching, Ger.). pp 107-15 of International Conference on Physics of Quiescent Plasmas. Pt. II. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.2).

Operation of the Garching ALMA III Q machine is briefly discussed. Construction of the rotating cathode system for the device is outlined. (M.O.W.)

26240 MODEL FOR SINGLE-ENDED Q MACHINE. Buzzi, J. M. (Ecole Polytechnique, Paris). pp 151-8 of International Conference on Physics of Quiescent Plasmas. Pt. II. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.2).

The existence of non-Maxwellian distribution functions is shown by applying the collisionless thermionic converter model, and the fact is emphasized that in a perfect one-dimensional model, the distribution functions depend on the cold end-plate polarization. (M.O.W.)

26241 DEVELOPMENT OF A SECOND-GENERATION QUIESCENT PLASMA SOURCE: THE ECH Q MACHINE. Michael, D.; McLeod, J.; Dreicer, H. (Los Alamos Scientific Lab., N. Mex.). pp 39-47 of International Conference on Physics of Quiescent Plasmas. Pt. III. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.3).

The development of a quiescent plasma column is discussed which, instead of a hot plate, utilizes a modest amount of microwave power at or near electron cyclotron resonance to ionize hydrogen gas and heat the electrons. Plasma measurements in the device are discussed. (M.O.W.)

26242 NEW OPERATING HOT PLATE WITH PROGRAMMABLE TEMPERATURE PROFILES. Wittman, F. E.; Henderson, D. B.; Dreicer, H. (Los Alomas Scientific Lab., N. Mex.). pp 73-7 of International Conference on Physics of Quiescent Plasmas. Pt. III. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.3).

Many Q-machine observations have indicated the desirability of hot-plate temperature profile control. To achieve this, a three-stage electron bombardment hot-plate system based on detailed heat transport computations was constructed. The three-inch-diameter hot plate is welded into a support disc and, to achieve azimuthal symmetry, is heated by coaxial electron beams. For isothermal operation a uniform cylindrical electron beam supplies the $\epsilon\sigma T^4$ power radiated by the hot plate, and a thin hollow cylindrical electron beam surrounding the uniform beam replenishes heat conducted from the hot plate edge to the cylindrical support disc. Both beams originate on a space-charge-limited intermediate hot plate which is, in turn, heated by electrons accelerated from a conical tungsten foil filament designed to minimize j × B distortion. X–Y recorder scans taken across the hot plate with an infrared pyrometer confirm that separate control of the coaxial beams permits the electrical programming of temperature profiles for which dT/dr is positive, negative, or everywhere nearly zero. The ability to select a temperature profile simply and reproducibly by changing power supply voltages is expected to provide a new degree of freedom in producing plasma quiescence and in studying some drift-wave instabilities. (auth)

26243 SEALED-OFF, SPACE-CHARGE LIMITED BOMBARDMENT DIODE FOR Q MACHINES. Abrams, R. H. Jr. (Univ. of Maryland, College Park); Lashinsky, H.; McRae, R. C. pp 79-85 of International Conference on Physics of Quiescent Plasmas. Pt. III. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.3).

A Q device that has the electron-bombardment diode section isolated from the main vacuum chamber is described. Some of the pertinent design considerations, the construction, and the performance of this gun are described. (M.O.W.)

26244 ISOTHERMAL HEATING OF CATHODES BY A HEAT PIPE. Shroff, A. M.; Imbert, F. (Thomson-CSF Centre, Corbeville, France). pp 87-94 of International Conference on Physics of Quiescent Plasmas. Pt. III. Paris; Ecole Polytechnique (1969). (In French).
See CONF-690923(Pt.3).

The heat pipe is proposed as a new method for the isothermal heating of cathodes. This is a relatively simple apparatus, and contains no moving parts. It uses the heat liberated by condensation of a previously evaporated fluid. The return of this fluid from the condensor to the evaporator is made by a capillary system. A comparison was made between the distribution of temperatures on a cathode heated by a heat pipe and on a cathode heated by electron bombardment. On the lateral surface of the heat pipe no variation of temperature is registered, but the obtaining of an isothermal heating by an extremity requires certain precautions. In addition, several measurements of the emission factor for different states of the tantalum surface are proposed. (J.F.P.)

Wave Phenomena

Refer also to abstracts 26191, 26222, 26224, and 26234.

26245 (AD-697979) LONGITUDINAL OSCILLATIONS IN BOUNDED ONE-DIMENSIONAL NONUNIFORM PLASMAS. Harker, K. J.; Kino, G. S.; Eitelbach, D. (Stanford Univ., Calif. Inst. for Plasma Research). Sep 1967. Contract Nonr-255(48). 32p. (SU-IPR-197). CFSTI.

Oscillations in a one-dimensional nonuniform plasma bounded by specularly reflecting walls were studied. The nonuniformity is assumed to arise from a parabolic-shaped static potential distribution. Static magnetic fields and longitudinal propagation are not included. Using Maxwell's equations and the linearized Boltzmann–Vlasov equation, a linear integral equation is derived. This equation is solved numerically to yield the resonances and damping rates of the various modes of the plasma. An alternative solution is obtained by using pressure theory. Comparison of results obtained by both methods shows good agreement, in contrast to earlier results for an infinite plasma, for which the agreement was poor. (auth) (USGRDR)

26246 (AD-700993) COMPUTER SOLUTIONS OF WAVE PROPAGATION THROUGH NONUNIFORM PLASMA LAYERS. Tischer, F. J. (Harry Diamond Labs., Washington, D. C.). Oct 1969. 30p. (HDL-TR-1467). CFSTI.

Complex reflection and transmission coefficients are determined by computer for symmetrically nonuniform plasma layers. The electron densities vary within the layers according to $1 - x^8$, $1 - x^4$ and $1 - x^2$ for $1 < x < +1$ at constant collision frequency. Infinite slabs and nonuniform layers in a waveguide are considered. Graphs of the complex reflection and transmission coefficients and of the changes caused by the nonuniformities are shown in terms of normalized plasma parameters. The method of computation, the computer program, and the diagrams are useful in plasma diagnostics and communications. In diagnostics, probing waves are transmitted through a nonuniform plasma layer between horn antennas or in a waveguide test section. In communications, waves are transmitted through plasma layers in front of a horn antenna. (auth) (USGRDR)

26247 (N-70-14545) MODIFIED EXTRAORDINARY MODE IN MAGNETIZED PLASMAS WITH RELATIVE STREAMING. Bornatici, M.; Lee, Kai Fong (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Nov 1969. 15p. (NASA-TM-X-63772; X-641-69-487). CFSTI.

It is shown that, for a system composed of two identical electron streams in relative motion across a magnetic field, a new low-frequency propagation band occurs for elliptically polarized waves propagating perpendicular to both the magnetic field and stream motion. No low-frequency cutoff exists if the plasma frequency is higher than the electron cyclotron frequency. This modified extraordinary mode becomes unstable for wave numbers greater than some minimum value when the streaming velocity exceeds a certain threshold value. The case of two identical counterstreaming electron–ion plasmas is also discussed. (auth) (STAR)

26248 (N-70-15129) PLASMA OSCILLATIONS IN A SPHERICAL, MAGNETIZED, COLD CATHODE DISCHARGE. Schmidt, P. E.; Quinn, R. G. (Pennsylvania State Univ., University Park. Ionosphere Research Lab.). 20 Oct 1969. 73p. (NASA-CR-107550; SR-341). CFSTI.

Plasma oscillations of very low frequency were found in a cold cathode dc discharge, where the cathode consists of an uniformly magnetized sphere. Under certain pressure and discharge conditions the plasma becomes trapped in the magnetic dipole field of the cathode. Under these conditions plasma oscillations occur. The plasma oscillations were studied in detail with respect to the two-terminal characteristic of the device. It was found that the frequency of the plasma fluctuations decreases with increasing current, gas pressure, ion mass, and decreasing voltage. No dependence of the frequency on the external series resistance or magnetic field is noticeable. The oscillations are rich in harmonics. In addition to the fundamental, the 2nd and 3rd harmonic were studied. Experimentally, it was found that $f = AR_{dc}$ where f is the frequency, A a constant dependent upon pressure and R_{dc} is the ratio of the dc voltage between the electrodes and the dc discharge current. (auth) (STAR)

26249 PROBLEM OF PROPAGATION OF THE ELECTROMAGNETIC SIGNAL IN INHOMOGENEOUS PLASMA. Brahmer, A. (Inst. of Fundamental Technical Problems, Warsaw). Arch. Elektrotech. (Warsaw); 17: 273-84(1968). (In Polish).

Properties of the electromagnetic signal propagated in an inhomogeneous dispersive-medium- plasma were investigated. The usefulness of the classical and asymptotic methods for analysis is discussed. Further, the asymptotic method for solution of hyperbolic dispersive equations was applied to the equations describing wave propagation in plasma with spherically symmetric inhomogenity. (auth) (NSA of Poland)

26250 SCATTERING OF ELECTROMAGNETIC WAVE FROM A PLASMA OF FINITE SIZE IN SPACE AND TIME. Iwama, Naofumi; Tsukishima, Takashige (Nagoya Univ., Japan). Trans. Inst. Electron. Commun. Eng. Jap., Part B; 52: 234-41(Apr 1969). (In Japanese).

The statistical error of measured values is discussed in the case where scattering of electromagnetic waves from uniform steady plasma is observed for a finite time interval with a receiver of finite aperture and bandwidth. Assuming the normal distribution for the fluctuation of electron density, and adopting as the degree of freedom a quantity defined by the ratio of square of the expected value to the dispersion, it is deduced from discussions of the random process that (1) when the incident wave is a plane monochromatic wave, the degree of freedom of the system is expressed approximately as the product of that for time filter and that for two-dimensional space filter, while those for time interval and for effective length in scattering direction degenerate, and (2) this degeneracy is removed when the incident plane wave is not monochromatic (with negligible beam divergence), and the degree of freedom becomes a function of scattering angle. In the limit of zero-frequency width, or zero scattering angle, this function converges to the expression for the plane monochromatic wave. (NSA of Japan)

26251 PARAMETRIC EXCITATION OF EXTRAORDINARY WAVES IN COLD PLASMA. Das, K. P. (Jalpaiguri Government Engineering Coll., West Bengal, India). J. Phys. Soc. Jap.; 28: 1310-14(May 1970).

The asymptotic method of Krylov, Bogolyubov and Mitropolskii is applied to study the possibility of excitation of extraordinary waves in a cold plasma by a small and periodic external electric field. Excitation conditions and maximum growth rate are deduced. (auth)

26252 WEAK NONLINEAR MAGNETO-ACOUSTIC WAVES IN A COLD PLASMA IN THE PRESENCE OF EFFECTIVE ELECTRON-ION COLLISIONS. Kawahara, Takuji (Kyoto Univ.). J. Phys. Soc. Jap.; 28: 1321-9(May 1970).

A nonlinear perturbation method is applied to describe the behavior of unsteady magneto-acoustic waves of small but finite amplitude propagating in a cold plasma in the presence of effective electron-ion collisions. It is shown under an assumption of small effective collision frequency that the original system of equations can be reduced to a single nonlinear equation that has a combined form of the Korteweg–de Vries and the Burgers equations. The dispersion term is just the same as that of collisionless case, whereas the dissipation term is found to be proportional to the magnetic viscosity. A qualitative discussion is given concerning the steady solutions of this equation. (auth)

26253 DISPERSION AND DAMPING OF ELECTROSTATIC ION WAVES IN A UNIFORM MAGNETIC FIELD. Hirose, A.; Alexeff, I.; Jones, W. D. (Oak Ridge National Lab., Tenn.). Phys. Fluids; 13: 1414-16(May 1970).

Dispersion and electron Landau damping of electrostatic ion waves in a magnetically supported plasma were experimentally investigated for propagation angles $0° \leq \Theta \leq 90°$ and frequencies $0.2\omega_{ci} \lesssim \omega \lesssim 3\omega_{ci}$. For the most part, good agreement with theory is found. (auth)

26254 WAVE–WAVE COUPLING IN ION WAVE PROPAGATION. Ohnuma, Toshiro; Hatta, Yoshisuke (Tohoku Univ., Sendai). Phys. Fluids; 13: 1416-17(May 1970).

In the propagation of two ion waves (frequencies f_1 and f_2) the signal of $f_1 - f_2$ is found to grow spacially in some region, contrary to the monotonic damping of the waves of f_1 and f_2, which is explained as a wave–wave coupling among ion waves. (auth)

26255 VALIDITY OF THE ELECTROSTATIC APPROXIMATION. Montgomery, David (Univ. of California, Berkeley). Phys. Fluids; 13: 1401-3(May 1970).

Criteria are derived for the existence of normal modes in a magnetized plasma for which $|\nabla \times E| \ll |\nabla \cdot E|$. The condition is different from the frequently quoted condition of thermal pressure ≪ magnetic pressure. (auth)

26256 UPPER HYBRID RESONANCE SCATTERING BY NONUNIFORM PLASMA COLUMNS. Greenwald, Raymond; Boley, Forrest I. (Dartmouth Coll., Hanover, N. H.). Phys. Fluids; 13: 1380-8(May 1970).

Extraordinary mode scattering spectra in the vicinity of upper hybrid resonance are calculated for an infinitely long, radially inhomogeneous, magnetoplasma column. The wave fields are determined inside the plasma column by a numerical solution of the full set of Maxwell's equations. The results indicate that enhanced scattering is limited to the range of upper hybrid frequencies of the column, that the shape of the resonance spectrum is strongly dependent on the shape of the density profile, and that the presence of a glass sleeve about the plasma column can completely change the shape of the resonance spectrum. Experimental scattering spectra and density profile measurements have been obtained from a thermally ionized potassium plasma column enclosed in a Pyrex tube and shunting a section of waveguide. The profile was measured with Langmuir probes. The spectrum predicted by the modified profile was found to be in very good agreement with an experimental spectrum obtained while the density measurements were being made. (auth)

26257 INSTABILITIES IN PARAMETRIC OSCILLATIONS OF A PLASMA IN A MAGNETIC FIELD. Prasad, R. (Bengal Engineering Coll., Howrah, India). Phys. Fluids; 13: 1310-21 (May 1970).

A dispersion relation for transverse waves with a propagation vector along the direction of a constant magnetic field pervading a plasma medium in response to an externally applied circularly polarized or hybrid electric field with the electric vector perpendicular to the magnetic field was obtained. The zero-order state of the plasma is defined by these external fields with a zero-order plasma current and a zero-order external current, both of which have oscillatory parts with frequencies v (frequency of the applied field) and Ω (the electron cyclotron frequency). It was shown that in all cases the left-hand mode is excited with frequency $\simeq\Omega - \omega_0$, where ω_0 is the electron plasma frequency, and instabilities may occur provided Ω is large. Excitation and instabilities are also possible with frequency $\simeq v - \omega_0$ in both modes under certain restrictions. The principal criterion for these restrictions is the validity of the assumption of spatial homogeneity of the imposed electric field. (auth)

26258 LINEAR INSTABILITY OF SOME FINITE AMPLITUDE ION WAVES. Su, C. H. (Brown Univ., Providence). Phys. Fluids; 13: 1275-80(May 1970).

The linear instability of periodic wave trains in a plasma consisting of cold ions and equilibrium electrons without magnetic field is studied. Small- but finite-amplitude wave trains with infinitesimal disturbances are considered using the method commonly used in parametric resonance. It is found that periodic waves are unstable if the square of their wave speed [normalized by the ion acoustic speed $(KT_e/m_i)^{1/2}$] is less than $1/3$. (auth)

26259 THEORY OF STABILITY OF LARGE PERIODIC PLASMA WAVES. Goldman, Martin V. (Univ. of California, Los Angeles). Phys. Fluids; 13: 1281-9(May 1970).

A method is developed for examining the stability of a large-amplitude periodic Bernstein–Greene–Kruskal wave, E_0, in a collisionless plasma. Vlasov's equation is integrated by the method of characteristics to yield a polarization charge density response ρ_1, linear in a small-amplitude field E_1, but nonlinear in E_0. The susceptibility linking ρ_1 and E_1 is expressed in terms of the exact orbits of trapped and untrapped particles in the field E_0 distributed in energy according to an assumed BGK distribution function f_0. These susceptibilities couple the Fourier components of E_1 in the usual mode-coupling fashion, but trapping effects are now included. For fields E_0 not too large, the mode-coupling problem reduces to finding the zeroes of a 2 × 2 or 3 × 3 determinant. Trapped electron distribution functions localized at the bottom of the potential energy troughs of E_0 give the growing side-band instability of Kruer, Dawson, and Sudan. (auth)

26260 LANDAU DAMPING OF ION ACOUSTIC WAVES IN A UNIFORM MAGNETIC FIELD. Hirose, A.; Alexeff, I.; Jones, W. D. (Oak Ridge National Lab., Tenn.). Phys. Fluids; 13: 1290-7(May 1970).

Landau damping of ion–acoustic waves in a relatively weak magnetic field was experimentally studied. Both artificially created contaminant Landau damping and electron Landau damping were examined for arbitrary propagation angles from 0° (parallel) to 90° (perpendicular). It was found that, for perpendicular propagation, the contaminant Landau damping disappears for wave frequencies ω such that $\omega < \omega_{ci}^{He}$. Also, for $\omega > 4\omega_{ci}^{He}$, the damping without magnetic field was completely recovered. Electron Landau damping is observable only when the waves propagate almost perpendicularly to the magnetic field. The wave frequency was kept much higher than the major ion cyclotron frequency so that the ion–acoustic waves could propagate in any direction. (auth)

26261 PENETRATION OF AN ELECTROMAGNETIC WAVE INTO A HOT PLASMA SLAB. Blevin, H. A.; Reynolds, J. A.; Thonemann, P. C. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Phys. Fluids; 13: 1259-64(May 1970).

The penetration of a small-amplitude high-frequency electromagnetic wave into a plasma slab is calculated making allowance for the thermal motion of electrons. For low collision rates the electromagnetic field distribution in the plasma is strongly dependent on the ratio of the wave period to the transit time of electrons crossing the slab. (auth)

26262 POWER SPECTRUM OF RADAR RETURNS FROM AN UNDERDENSE, TURBULENT, IONIZED GAS. Johnson, Kent R. (Mitre Corp., Bedford, Mass.). Phys. Fluids; 13: 1230-7(May 1970).

An analysis is given of the time autocorrelation function and the power spectrum to be anticipated in electromagnetic scattering from an underdense, turbulent, ionized gas. The autocorrelation function and power spectrum are obtained in terms of a parameter describing electron density decay and of parameters describing the turbulence. It is shown that when electron density decay is significant, broader spectra, and slower decay of spectral width may be obtained than might be anticipated by the application of the usual Doppler formula to the rms turbulent velocity fluctuation. (auth)

26263 LARGE-AMPLITUDE ION WAVES IN A DECAYING PLASMA. Shukhtin, A. M.; Skrebov, V. N.; Polyanskii, M. N. Opt. Spectrosc. (USSR)(Engl. Transl.); 27: 308-11(Oct 1969).

Translated from Opt. Spektrosk.; 27: 566-72(Oct 1969).

A pulsed discharge in mercury vapor at $P_0 = 0.2$ to 3 torr and $j = 150$ to 500 A/cm^2 was investigated. The use of optical methods disclosed the existence of radial oscillations of the luminescence intensity and density of the substance in the course of the plasma decay. It is shown that these oscillations are due to large-amplitude ionic waves. The dependence of the oscillation period on the discharge conditions was studied. High amplitude ionic waves are shown to exist only at high energies introduced into the discharge. At energies less than 0.5 J, acoustic oscillations of neutral mercury atoms were observed. The cause of the generation of high-amplitude ionic waves and the possibility of their utilization for diagnostic purposes are discussed. (auth)

26264 SELF-EXCITED ION-ACOUSTIC AND DRIFT WAVES IN A RADIOFREQUENCY PLASMA. Caldirola, P.; Bernabei, S.; De Dionigi, R.; Fontanesi, M.; Lisitano, G.; Sindoni, E. (Univ., Milan). pp 15-22 of International Conference on Physics of Quiescent Plasmas. Pt. I. Paris; Ecole Polytechnique (1969).

See CONF-690923(Pt.1).

Self-excited drift and ion–acoustic waves were simultaneously detected in a rf plasma. The plasma was produced in ECR condition by means of a slow-wave structure excited with a rf 3-GHz, 50 Watt cw source. Data are given. (M.O.W.)

26265 SPHERICAL ELECTRO-ACOUSTIC WAVES IN DRIFTING PLASMAS. Grard, R. J. L. (European Space Research and Tech. Centre, Noordwijk, Netherlands). pp 31-7 of International Conference on Physics of Quiescent Plasmas. Pt. I. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.1).

An equation pertaining to spherical waves such as those generated by a point charge is presented. Experiments are described on the propagation of ion–acoustic perturbations in drifting plasma. The experimental conditions are such that the drift velocity of the plasma is higher than the ion–acoustic wave velocity. A propagation cone is observed for the ion–acoustic waves and information is obtained on the electron temperature and the bulk motion of the plasma. (M.O.W.)

26266 ION-ACOUSTIC WAVES IN STREAMING-ION PLASMA. Ikegami, H.; Kawai, Y. (Nagoya Univ., Japan). pp 47-54 of International Conference on Physics of Quiescent Plasmas. Pt. I. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.1).

An experimental observation was made of grid-excited ion-acoustic waves and their spatial behavior was studied. The exchange of energy between waves and particles is observed and referred to the damping in space of the waves. A description of the experiment along with wave measurements and nonlinear effects is given. (M.O.W.)

26267 INFLUENCE OF A BIASED GRID ON THE PLASMA IN A SINGLE-ENDED Q MACHINE. Andersen, H. K.; Andersen, S. A.; Jensen, V. O.; Michelsen, P.; Nielsen, P. (Risoe Research Establishment, Roskilde, Denmark). pp 55-60 of International Conference on Physics of Quiescent Plasmas. Pt. I. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.1).

The plasma on the downstream side of a biased grid was examined. It was found that: (a) The drift velocity, ion temperature, and plasma potential are independent of grid voltage; (b) pulses released by short pulses applied to the grid propagate in a self-similar fashion; and (c) the wave–particle interaction expected from a linearized theory was observed by means of an energy analyzer. (auth)

26268 GREEN FUNCTION FOR ION-ACOUSTIC WAVES. Nielsen, P. (Risoe Research Establishment, Roskilde, Denmark). pp 61-7 of International Conference on Physics of Quiescent Plasmas. Pt. I. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.1).

The propagation of ion acoustic waves in single-ended Q devices was studied. A Green function was determined for density defined as the perturbation due to an initial δ pulse. The propagation of sinusoidal waves may be obtained as the convolution integral of this result and exp $(-i\omega t)$. (M.O.W.)

26269 PROPAGATION OF IONIC WAVES: THEORETICAL INTERPRETATION OF THE BALLISTIC SIGNAL. Nguyen Quang, D. (EURATOM-CEA, Fontenay-aux-Roses, France). pp 69-74 of International Conference on Physics of Quiescent Plasmas. Pt. I. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.1).

At this time, sufficient knowledge has been gathered by experiments on the propagation of longitudinal ionic waves, to call for a comprehensive theoretical interpretation of the ballistic signal. One is suggested here that is based on kinetic theory and on the excitation mechanism. In the light of experimental data, it is clear that theory has to consider both phenomena of ion bunching and ion burst. Each of them is to be dominant in different sets of experimental conditions. (auth)

26270 EXPERIMENTS ON LINEAR ION-BALLISTIC PSEUDO WAVES. Doucet, H. J.; Gresillon, D. (Ecole Polytechnique, Paris). pp 75-84 of International Conference on Physics of Quiescent Plasmas. Pt. I. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.1).

Grid excitation of longitudinal waves in Q-machine plasmas was studied. The classical kinetic theory predicts than an initial perturbation $(t = 0)$ will develop with Fourier–Laplace components ω,k in time and space, following some dispersion relation $D(\omega,k) = 0$. Unfortunately, the basic assumption of initial perturbation does not hold in experiments on longitudinal waves, which are always boundary-value problems. The kinetic solution is then different, as pointed out first by Landau in the second part of his original paper on electron waves. Experimental evidence is shown of a physical solution that appears as the sum of two signals, one obeying the dispersion relation of the initial-value problem already studied and the second exhibiting new features very much similar to those of Hirshfield's model. A numerical model is presented, like the one from M. Widner et al., on trajectories of particles in a grid, which may trace the validity limits of a linear kinetic model, and enlighten on other types of pseudo waves already reported. (auth)

26271 PSEUDOWAVES: MULTIPLE AND DISPERSIVE; ION WAVES IN A MAGNETIC FIELD; AND NON-LINEAR PHENOMENA. Alexeff, I.; Hirose, A.; Jones, W. D.; Lonngren, K.; Widner, M. (Oak Ridge National Lab., Tenn.). pp 85-92 of International Conference on Physics of Quiescent Plasmas. Pt. I. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.1).

Three phenomena are considered: (1) "Multiple" and "ordinary" pseudowaves (ion bursts). Multiple pseudowaves are explained in terms of ions oscillating in the sheath around the grid. Ordinary pseudowaves are observed to exhibit two types of dispersion: that due to phase mixing caused by the ion thermal velocity spread, and that caused by the finite rise time of the excitation voltage; (2) Electrostatic ion waves in a magnetically supported plasma column. Resonances and cutoffs, and ion and electron Landau damping as a function of wave frequency and propagation angle were observed; (3) Computer simulations of nonlinear phenomena. Problems studied include the ion wave excitation process at a negatively pulsed surface, ion wave reflection by and detection through a steady-state sheath, expansion of a plasma into a vacuum, and the effects of ion–neutral collisions on these processes. (auth)

26272 SYMMETRY CONSIDERATIONS FOR GRID-LAUNCHED ION-ACOUSTIC WAVES. Jacob, J. H.; Hirshfield, J. L. (Yale Univ., New Haven). pp 93-106 of International Conference on Physics of Quiescent Plasmas. Pt. I. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.1).

Immersion of a fine-mesh grid (or set of parallel grids) into a plasma is used widely to stimulate ion–acoustic waves. The grid structure is usually biased so as to reflect electrons and transmit ions. The effect upon the ions due to applied rf fields in the grid region is to provide some combination of either velocity or density modulation. The associated applied electric field perturbations will possess a combination of odd and even spatially symmetric parts along the plane of the grid system. The steady-state solution of the Vlasov–Poisson equations for $\omega < \omega_{pi}$ and $T_e \gg T_i$ is shown to depend critically upon this source symmetry, and to reduce to the usual solution only for the case of odd symmetry. Experiments designed to test these symmetry predictions were carried out using an apparatus described previously, except that a 4-grid transmitter was substituted for the 3-grid one. The outer two grids are grounded and the inner two grids can be driven either in phase (odd E-field symmetry), or 180° out of phase (even E-field symmetry). For odd symmetry, the observed spatial disturbance is similar to that reported earlier, with clear evidence of Fresnel interference. For even symmetry, wave-like signals are not observed near the grids, indicating a strong decrease in coupling between the free-streaming source ions and an ion-acoustic wave. Implications of the observations for the interpretation of observed spatial decays are discussed. (auth)

26273 RADIAL ION RESONANCES IN BOUNDED PLASMAS WITH AND WITHOUT MAGNETIC FIELD. Messiaen, A. M.; Weynants, R. R.; Vandenplas, P. E. (Ecole Royale Militaire, Brussels). pp 107-14 of International Conference on Physics of Quiescent Plasmas. Pt. I. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.1).

The excitation and detection of dipolar ion–acoustic resonances were studied and indicate at least partial reflection and non-zero cutoff of cylindrical axially propagating waves. The effects of a perpendicular static magnetic field on these resonances are investigated. (M.O.W.)

26274 CONSTANT-FREQUENCY OSCILLATION IN CURRENT-CARRYING THERMAL PLASMA. Fang, M. T. C.; Fraser, D. A.; Allen, J. E. (Oxford Univ.). pp 115-22 of International Conference on Physics of Quiescent Plasmas. Pt. I. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.1).

The plasma was produced between two concentric tantalum cylinders heated to 2500°K by electron bombardment. Oscillations occurring in the discharge are described. A brief theoretical analysis is also given. (M.O.W.)

26275 ION OSCILLATIONS IN AN ALKALI PLASMA DIODE. Enriques, L. (CNEN, Frascati, Italy). pp 123-31 of International Conference on Physics of Quiescent Plasmas. Pt. I. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.1).

The plasma inside two infinite and parallel hot tantalum plates is studied. Oscillations were observed. A theoretical interpretation of the oscillations is given. (M.O.W.)

26276 NONLINEAR INTERACTION OF COHERENT ELECTRON PLASMA WAVES. Franklin, R. N. (Oxford Univ.); Barrett, P. J. pp 133-42 of International Conference on Physics of Quiescent Plasmas. Pt. I. Paris; Ecole Polytechnique (1969).

Resonant and nonresonant coupling between two coherent electron plasma waves (ω_1,k_1) and (ω_2,k_2) propagating in opposite directions, and the related phenomenon of the parametric decay of an electron plasma wave (ω_1,k_1) into an electron plasma wave (ω_2,k_2) and an ion–acoustic wave (ω_3,k_3) are discussed. Computed values are presented of the coefficients corresponding to each of the three types of interaction, based on the numerical method of obtaining the plasma dispersion function. Implications of these results for the experimental observation of this particular resonant and nonresonant coupling are considered. (M.O.W.)

26277 ION–ACOUSTIC WAVES IN A SINGLE-ENDED Q MACHINE. Yadlowsky, E. J.; Abrams, R. H. Jr.; Lashinsky, H. (Univ. of Maryland, College Park). pp 143-50 of International Conference on Physics of Quiescent Plasmas. Pt. I. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.1).

The conditions for excitation of ion–acoustic waves in Q devices are discussed. A brief discussion of the theory and experiment is given. (M.O.W.)

26278 MODEL IN PHASE SPACE TO STUDY NONLINEAR PLASMA OSCILLATIONS: THE WATER BAG. Bertrand, P.; Feix, M. R.; Baumann, G. (Univ., Nancy). pp 151-7 of International Conference on Physics of Quiescent Plasmas. Pt. I. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.1).

Solutions are presented for electron plasma oscillations using the water bag model. Second and third harmonics are plotted from the calculations. (M.O.W.)

26279 NONLINEAR ION–ACOUSTIC WAVES. Doucet, H. J.; Gresillon, D.; Schmitt, J. (Ecole Polytechnique, Paris). pp 167-74 of International Conference on Physics of Quiescent Plasmas. Pt. I. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.1).

Nonlinear theory of undamped ion–acoustic waves in hot collisionless plasma is investigated, using a model given by W. P. Allis for electronic waves. Exact solutions of the Vlasov equation are used in order to demonstrate that undamped ion–acoustic waves, even with large amplitudes, can exist. (auth)

26280 PENETRATION OF ELECTROMAGNETIC WAVES IN A PLASMA WITH A STATIC MAGNETIC FIELD. Moresco, M.; Zilli, E. (Univ., Padua). pp 175-82 of International Conference on Physics of Quiescent Plasmas. Pt. I. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.1).

The penetration is studied in the case of a plasma in a uniform dc magnetic field B_0; a wave whose direction of propagation and electric field are perpendicular to B_0 is considered. The cases of a low-beta plasma and a weak magnetic field are considered. (M.O.W.)

26281 EFFECT OF HEAT TRANSPORT ON THE COLLISIONAL DRIFT-WAVE DISPERSION RELATION. Gravier, R.; Laval, G.; Pellat, R.; Renaud, C. (CEN, Fontenay aux Roses, France). pp 1 of International Conference on Physics of Quiescent Plasmas. Pt. II. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.2).

A dispersion relation for the problem is given. (M.O.W.)

26282 RESISTIVE DRIFT WAVES IN AN INHOMOGENEOUS ADIABATIC PLASMA. Auer, G. (Innsbruck Univ.). pp 3-10 of International Conference on Physics of Quiescent Plasmas. Pt. II. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.2).

The normal modes for electrostatic waves in an adiabatic plasma were investigated. The modes present in the isothermal case are only slightly changed. Besides this, two new modes occur: waves traveling with the γ-fold ion and electron drift velocity and those that turn over into acoustic waves for larger values of the parallel wave number. As to growth rate, they are practically stable. (auth)

26283 COLLISIONAL DRIFT WAVES IN TWO-ION-SPECIES PLASMAS. Verheest, Frank (State Univ., Ghent). pp 19-26 of International Conference on Physics of Quiescent Plasmas. Pt. II. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.2).

A dispersion relation is derived for a plasma with two different kinds of ions. A brief analysis of the stability of a two-component system is also given. (M.O.W.)

26284 EXPERIMENTAL INVESTIGATION OF NONLINEAR INTERACTIONS OF DRIFT WAVES. Hosken, Robert W. (Univ. of Illinois, Urbana). pp 49-56 of International Conference on Physics of Quiescent Plasmas. Pt. II. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.2).

An experiment to study the nonlinear interaction of a plasma wave and an ordinary collisionless drift wave is described. The plasma wave and the wave–wave mixing are investigated. (M.O.W.)

26285 APPARENT PARAMETRIC ENHANCEMENT OF A DRIFT-TYPE INSTABILITY. Keen, B. E.; Aldridge, R. V. (Culham Lab., Abingdon, Eng.). pp 65-72 of International Conference on Physics of Quiescent Plasmas. Pt. II. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.2).

Results are presented concerning the apparent enhancement of a drift-type instability by an externally applied signal whose frequency was twice that of the instability. The experiments were performed using a hollow cathode argon arc plasma. (M.O.W.)

26286 NONLINEAR ASPECTS OF DRIFT INSTABILITIES. Hai, Francis; Wong, Alfred Y. (Univ. of California, Los Angeles). pp 81-9 of International Conference on Physics of Quiescent Plasmas. Pt. II. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.2).

Research on the following three nonlinear aspects of drift waves is reported: (1) measurement of the linear growth rate and nonlinear saturation coefficients of an unstable mode, (2) change of the damping rate of a stable mode as a function of amplitude, and (3) modification of the linear stability of a lower mode due to mode coupling from a higher unstable mode. (M.O.W.)

26287 DRIFT-WAVE FLUCTUATIONS AND ANOMALOUS DIFFUSION IN A FULLY IONIZED MAGNETOPLASMA. Walsh, J. (Dartmouth Coll., Hanover, N. H.); Schlesinger, S. P.; Josephy, K.; Marshall, T. C. pp 173-9 of International Conference on Physics of Quiescent Plasmas. Pt. II. Paris; Ecole Polytechnique (1969).
See CONF-690923(Pt.2).

An effective perpendicular diffusion coefficient, $D_\perp$, is compared with the amplitude of the fluctuations at the point where $D_\perp$ was measured. It was found that the $D_\perp$ vs $\overline{\delta n^2}$ curve follows the predictions of Dupree for large-amplitude drift-wave-driven diffusion. (M.O.W.)

Shielding

Refer also to abstracts 25263 and 25775.

26288 GREEN'S FUNCTIONS FOR MULTIDIMENSIONAL NEUTRON TRANSPORT IN A SLAB. Garrettson, G.; Leonard, A. (Stanford Univ., Calif.). J. Math. Phys. (N. Y.); 11: 725-40(Feb 1970).

The integral form of the one-speed, steady-state Boltzmann transport equation is solved for a point source in a homogeneous, isotropically scattering slab. In addition, solutions are obtained for line sources and plane sources in the slab, both normal and parallel to the slab faces. Using Fourier and Laplace transforms, the problem is reduced to that of solving a 1-dimensional integral equation with a difference kernel. This equation is transformed into a singular integral equation which is solved using standard methods. The Green's functions are subsequently obtained as generalized eigenfunction expansions over the spectrum of the 1-dimensional integral operator. This form yields a simple solution far from the source, and alternate expressions are obtained to facilitate evaluation near the source. In a thick slab the exact solutions are shown to reduce the simple closed expressions plus correction terms that decrease exponentially as the slab thickness increases. Most of the work previously done in multidimensional transport in slabs is shown to be easily reproduced using this theory in the thick-slab approximation. Also, virtually all other problems of this type can be solved using the theory presented here. In particular, the density from a pencil beam of particles normally incident to the slab is obtained. (auth)

26289 ALGORITHMS FOR MODELING THE RANDOM WAVE LENGTH OF COMPTON-SCATTERED γ QUANTA. Marenkov,

O. S. Zh. Prikl. Mekh. Tekh. Fiz.; No. 5, 128-9(Sep-Oct 1969). (In Russian)

Solution of the γ transfer problem in matter is related to the multiple modeling of Compton scattering; the wavelength in Compton units is used as the characteristic of the quanta. The random wavelength of the n-fold scattering of a γ quantum λ_n is determined by the Klein–Nishina distribution. Precise algorithms for modeling λ_n are based on the so-called random exclusion principle. A second algorithm was derived, determining the absolute maximum of the density probability function and comparing it with Kahn's algorithm. This involved the computer-based determination of the mean time of degradation of the γ-quantum energy from its initial to its final value, modeling only the slowing-down and not the total trajectory. The usefulness of the algorithm was found to depend on the initial and final energy values used. (TTT)

26290 BUILDUP FACTORS IN WATER FOR GAMMA RAYS OF 1 MeV AND LOWER ENERGY. Morris, E. E.; Chilton, A. B. (Univ. of Illinois, Urbana). Nucl. Sci. Eng.; 40: 128-9(Apr 1970).

An attempt is made to resolve the discrepancy between Berger's (J. Nuclear Med., Suppl. No. 1 (Feb. 1968)) point-source energy deposition (absorption) buildup factor values for deeper penetrations of 0.5-MeV gamma radiation in water and the corresponding values of Goldstein and Wilkins (NYO-3075). It is concluded that the data provided by Berger are to be preferred, where they differ. The justification for this conclusion is given. (M.H.R.)

26291 SOME RESULTS OF MEASURING NEUTRON FLUXES IN THE ARTIFICIAL EARTH SATELLITE "COSMOS-53". Bulatov, B. P.; Koridalin, V. E.; Petrov, V. M. Kos. Biol. Med.; 3: 16-24(May-Jun 1969). (In Russian).

A simplified method is given for calculating the neutron flux density in the construction material of the spacecraft generated under the influence of radiation-belt protons. It also contains the results of pertinent measurements performed by means of different detectors aboard the artificial Earth satellite Kosmos 53. The calculated value of the neutron flux density is found to be in good agreement with the measured value. (auth)

26292 ANGULAR DISTRIBUTION OF FLUX AND INTENSITY FROM GAMMA-RAY SCATTERING BY SHIELDING. Veselkin, A. P.; Glushchenko, A. I.; Egorov, Yu. A.; Orlov, Yu. V. At. Energ. (USSR); 27: 338-40(Oct 1969). (In Russian).

Previously it was shown that the angular dependence of the intensity of γ-radiation scattering by point source shielding could be described by $[dI(\theta)/d(\theta)] = C(e^{-}\ \theta/\theta_0/\sin\theta)$ (where θ is a angular distribution constant depending on the γ-radiation energy E_γ, on the shielding material, and only slightly, depending on the thickness). In order to expand the data for the θ_0 constants and to determine the dependence of θ_0 on the radiation energy, and on the atomic number of the shielding material, studies were made of the angular distribution of γ radiation from ^{60}Co (E_γ = 1.25 MeV) and ^{27}Na (E_γ = 2.76 MeV) passing through shielding made of lithium hydride, polyethylene, graphite, titanium, molybdenum, and tungsten. A single-crystal scintillation detector with a 100-mm NaI(Tl) crystal used in the studies showed that angular distribution of 1.25- and 2.76-MeV γ radiation behind the shielding of all examined materials was in good agreement with the published data. Thus, data obtained and published data indicate the means for calculating the angular distribution of intensity and flux of scattered γ radiation in the range from 0.41- to 2.76-MeV in any media. (R.V.J.)

Solid-State Physics

Refer also to abstracts 25725, 26580, and 26581.

Radiation Effects

Refer also to abstract 25658.

26293 ELECTRICAL PROPERTIES OF GAMMA-IRRADIATED p-TYPE SILICON. Cheng, L. J.; Lori, J. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Phys. Rev., B; 1: 1558-63 (15 Feb 1970).

Electrical-conductivity and Hall-coefficient measurements were used to investigate the production and annealing of defects which were produced in p-type silicon by ^{60}Co γ irradiation at 80°K. Gamma irradiation reduces the carrier concentration in the sample at 80°K. Two annealing stages occurring at 175 and 350°K are observed. An illumination with white light at 82°K after irradiation reduces not only the total damage, but also the fractions of the damage recovered in both stages and the remainder after the annealing up to 500°K. The results are consistent with the argument that the 175°K stage is due to the migration of the neutral vacancy, and the 350°K stage is due to the annealing of secondary defects, including some vacancy-impurity complexes. (auth)

26294 LOW-TEMPERATURE VOLUME EXPANSION OF LiH: LiT. Dellin, T. A. (Brookhaven National Lab., Upton, N. Y. City Univ. of New York, Flushing); Dienes, G. J.; Fischer, C. R.; Hatcher, R. D.; Wilson, W. D. Phys. Rev., B; 1: 1745-53(15 Feb 1970).

Crystals of LiH : LiT undergo self-damage due to the β decay of tritium. The low-temperature volume expansion associated with this damage has been investigated theoretically. Twenty-four defects relevant to the damage process have been studied. The results indicate that one of the various species of interstitial lithium is most likely responsible for the expansion, since these defects cause sufficiently large volume expansion to explain the experimental data. The calculations indicate that the Li_2^+ molecular ion is the favored interstitial species. In addition to the volume expansion, Li_2^+ can account for the observed NMR and ESR signals and it may well be the nucleus for subsequent lithium precipitation. (auth)

26295 STUDY OF THE DEPENDENCE OF THE SPEED OF ULTRASOUND IN ROCHELLE SALT AND AMMONIUM DIHYDROPHOSPHATE ON THE γ-RADIATION DOSE. Azizov, S. A. (Nizami State Teachers Inst., Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 4, 83(1969). (In Russian).

The relative change in the speed of ultrasonic waves in Rochelle salt and ammonium dihydrophosphate caused by exposure to γ radiation was determined for the rate of propagation of 1.67-MHz waves through the specimen and a reference solution of 25% ethyl alcohol in distilled water at room temperature. The measurements were carried on specimens exposed to a 6.8×10^5 R/hr γ source, cut in rectangular and oblique shapes. Irradiation of the oblique Rochelle salt at 40 and 56 MR was found to decrease the velocity by 4 to 5 and 9 to 11%, respectively; in the rectangular specimens a similar change was noted in the direction of the a and b axes while a linear decrease was noted in the direction of the c axis. This effect was attributed to radioinduced changes in the dimensions, microhardness, melting point, and gas release of the material. The decrease of the change of the rate of propagation of ultrasonic waves in ammonium dihydrophosphate was identical in both type of specimens, exposed to γ-radiation doses of 70 and 160 MR; the effect was due probably to the formation of defects in the crystals. (TTT)

26296 NEGATIVE-ION SPUTTERING OF COPPER, SILVER, AND GOLD TARGETS BOMBARDED BY POSITIVE Cs^+ IONS. Abdullaeva, M. K.; Ayukhanov, A. Kh. (Inst. of Electronics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 4, 60-3(1969). (In Russian).

The atomic and molecular ions encountered in the target material upon bombardment with Cs^+ ions may represent fragments of compounds of the target with adsorbed impurities or negative ions from cathodic sputtering, resulting from the change of the charge. The emission mechanism may be different, depending whether the secondary ions were dislodged from a chemical compound at the surface or come directly from the crystal lattice. The problem was studied by examining the ionic sputtering of Cu, Ag, and Au targets and their surface impurities by Cs^+ ions during the deposition of a cesium layer, using an ion-energy-modulated mass spectrometer. It was concluded that pulverization of the target in the form of negative ions may involve ordinary cathodic sputtering. The coefficient of ionic sputtering of these targets covered with an alkali metal layer may reach several tenths of percent. This makes it possible to study the cathodic sputtering mechanism by examining the transition of pulverized particles into the charged state and to create negative ion sources by the bombardment of a solid surface. (TTT)

26297 DISTURBANCE OF COLOR CENTERS OF NaCl SINGLE CRYSTALS IN THE PROCESS OF SHOCK COMPRESSION. Yakusheva, O. B.; Yakushev, V. V.; Dremin, A. N. (Inst. of Chemical Physics, Chernogolovka, USSR). Dokl. Akad. Nauk SSSR; 189: 991-2(11 Dec 1969). (In Russian).

Since the rate of decolorizing colored crystals is proportional to the concentration of traps in the crystals, for example, of vacancies absorbing optically excited electrons of F centers, the direct determination of the light absorption ability of single crystals containing F centers was carried out under shock compression. The light changes were followed in single crystals of NaCl which were colored by a dose of 0.75×10^6 r of ^{60}Co gamma rays, and which were subjected to shock compression along the [100] axis. Irradiation of the crystal with the intense light of an argon lamp for a period of about 13 microseconds did not lead to noticeable decolorization, which, however, did take place on entrance of the shock wave into the sample over a time less than 0.5 microseconds. Decolorization of the crystals during shock compression was noted for pressures p = 30 and 180 kbar. (TTT)

26298 COMPARISON OF AVERAGE-POTENTIAL MODELS AND BINARY-COLLISION MODELS OF AXIAL CHANNELING AND BLOCKING. Andersen, J. U.; Feldman, L. C. (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev., B; 1: 2063-9 (1 Mar 1970).

A comparison is made of three types of calculations of the axial "channeling dip": the large decrease in yield of close-encounter processes for energetic ions incident on a single crystal parallel to a low-index direction. The models, indicated as (1) the binary-collision model, (2) the halfway-plane model, and (3) the continuum model, are used to calculate the dip for two standard cases corresponding to recent experiments. The methods are compared as to treatment of potential and treatment of thermal vibrations. The ease of calculation versus quantitative accuracy for the different methods is discussed, and finally the agreement with experimental results is briefly reviewed. (auth)

26299 ANGULAR DEPENDENCE OF THE PRODUCTS FROM SPUTTERING InSb SINGLE CRYSTALS WITH FAST ARGON IONS. Agranovich, V. M.; Kapusta, O. I.; Lebedev, S. Ya.; Semenov, L. P. Sov. Phys.-Solid State (Engl. Transl.); 11: 2280-8(Apr 1970).

Translated from Fiz. Tverd. Tela; 11: 2816-26(Oct 1969).

The angular dependence of the sputtering from InSb single crystals due to argon ions with 70 keV energy was experimentally investigated. The activation analysis method shows that this angular dependence is different for the indium and the antimony. A theoretical analysis of the results shows that the observed asymmetry in the sputtering pattern can be explained using the mechanism of Lehman and Sigmund and also using the focusing mechanism with the presence of corresponding structure changes of the layer of the crystal near the surface. It is also shown that even in an ideal ionic crystal under the action of an ion beam there is an uncompensated electric charge whose surface density is proportional to the sputtering rate and the difference between the diffusion coefficients for In and Sb vacancies in the region of the electrical double layer investigated by Geguzin and Lifshits in contrast to thermal equilibrium conditions. The degree to which the electric field in the layer near the surface of the crystal can affect the sputtering pattern is discussed. (auth)

26300 MOBILITY OF DISLOCATIONS IN GAMMA-IRRADIATED SODIUM CHLORIDE CRYSTALS. Ermakov, G. A.; Nadgornyi, E. M. (Inst. of Solid-State Physics, Chernogolovka, USSR). Sov. Phys.-Solid State (Engl. Transl.); 11: 2362-7 (Apr 1970).

Translated from Fiz. Tverd. Tela; 11: 2916-21(Oct 1969).

The velocities v (10^{-6} to 1 cm/sec) of screw dislocations in pure NaCl crystals irradiated with various doses of gamma radiation (from 10^4 to 10^8 rad) were studied as functions of the applied shear stress τ. In the same crystals the optical absorption spectra were measured between wavelengths of 0.2 and 25 μ, together with the yield stress. There was no correlation between $v(\tau)$ and the concentration of F, M, or V color centers. Subsequent annealing of these centers (up to 200°C) had little effect on the dislocation mobility. The parameters of the $v(\tau)$ curves differed sharply at different stages on the color-center accumulation curves. It was concluded that the considerable additional retardation of the dislocations observed for all doses of radiation was due to interstitial ions (Frenkel defects), individually or in the form of aggregates, rather than to the color centers. These affected the locations mobility more than divalent cation impurities. (auth)

26301 COLOR CENTERS IN THE REACTOR-IRRADIATED NaCl, KCl, AND KBr CRYSTALS. Nishi, Masato; Ikeda, Masaomi; Fujii, Atsuhiro; Kato, Shohichi (Hiroshima Univ.). Mem. Fac. Eng., Hiroshima Univ.; 4: 23-32(Jan 1970). (In Japanese).

The optical absorption spectra of the reactor-irradiated NaCl, KCl, and KBr crystals were examined, and it was found that the types of the observed absorption bands of the color centers were not markedly different from those observed after the irradiation with x rays or other ionizing radiations. When the dynamical radiation equilibrium among F and F-aggregate centers is followed, M-center concentration vs the square of the F-center concentration, and R_2-center concentration vs the product of the concentrations of F and M centers show linear relations in the early coloring stage, but marked deviations from linearity are observed in the heavy coloring stage. (auth) (NSA of Japan)

26302 EFFECT OF POTASSIUM ON THE ROOM TEMPERATURE FIRST STAGE COLORABILITY OF NaCl. Takeuchi, Nozomu; Tsuchitani, Noboru (Tokushima Univ., Japan). Bull. Fac. Eng., Tokushima Univ.; 6: No. 1, 47-54(Aug 1969).

It is found experimentally that the presence of potassium impurity in NaCl crystal partially reduces the first-stage coloration when it is x-irradiated at room temperature. The relation of Etzel and Allard, i.e., $n_F = (m + b/E)^{-1}$ is ascertained to be valid for three crystals: air-grown NaCl, NaCl : Sr (0.03 mol %), and NaCl : K (3.0 mol %). It is found that the m values are chiefly characteristics of the samples and scarcely depend at all on x-ray intensity. (NSA of Japan)

26303 TEMPERATURE DEPENDENCE OF PRODUCTION RATE OF DIVACANCY AND NEAR EDGE ABSORPTION IN Si BY FISSION NEUTRONS. Cheng, L. J.; Lori, J. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Appl. Phys. Lett.; 16: 324-5 (15 Apr 1970).

The production rates of the 1.8-μ absorption band and the near edge absorption in Si irradiated by fission neutrons in the temperature range from 145 to 300°C were studied. The results indicate that for both the divacancy and the defects causing the near edge absorption, the annealing behavior during irradiation in this temperature range is the same as that after an irradiation at 50°C. (auth)

26304 ELECTRON AND ION BEAM SCIENCE AND TECHNOLOGY. VOLUME 2. Proceedings of the Second International Conference, New York, April 1966. Bakish, Robert (ed.). Metallurgical Society Conferences, Volume 51. New York; American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc. (1969). 603p. (CONF-660414-(Vol.2)).

Twenty-nine papers are presented in this volume under the following headings: Ion Propulsion, Electron Beams in Recording and Information Storage, Electron Beams in Micro Electronics, and Ion Beams in Micro Electronics. (D.L.C.)

26305 LATTICE LOCATION OF BORON IONS IMPLANTED INTO SILICON. Fladda, G.; Bjoerkqvist, K.; Eriksson, L.; Sigurd, D. (Research Inst. for Physics, Stockholm). Appl. Phys. Lett.; 16: 313-15(15 Apr 1970).

Channeling-effect measurements were used to investigate the lattice location of boron atoms implanted into silicon at an energy of 56 keV and with doses in the interval 10^{14} to 10^{15} ions/cm^2. Measurements were made as a function of implantation temperature and subsequent anneal treatment. The effect of post-bombardment with different doses of 680-keV protons was investigated. (auth)

26306 THE γ-RAY-INDUCED ELECTRIC CONDUCTIVITY OF FUSED SILICA AS DEPENDENT ON FIELD STRENGTH, TEMPERATURE, AND IRRADIATION TIME. Onnasch, D. (Univ., Kiel). Phys. Status Solidi; 38: 579-92(1 Apr 1970).

The γ-ray-induced electric conductivity in fused silica is studied theoretically and experimentally as a function of temperature, electric field strength, sample thickness, and irradiation time. Synthetic glasses containing water show the highest induced conductivity. Caused by an increase of positive centers capturing the excited electrons, the conductivity decreases as $t^{-\alpha}$ with the irradiation time t, where $\alpha < 1$ is a constant, depending on temperature. Within the range from 8 to 300°K, induced currents are measured with voltages up to 2500 V and dose rates between 10 and 200 Mrad/sec in synthetic samples 0.2 to 4 mm thick. The gradual transition from constant conductivity at high temperatures and low field strengths F to an increase of conductivity proportional to F or $F^{1/2}$ at low temperatures and high field strengths is explained by the deformation of the Coulomb potential of 2×10^{12} to 5×10^{14} cm^{-3} singly ionized, electron-capturing centers under the action of the applied field. The comparison of the theoretical dependence of the electron lifetime on field strength and temperature with the measurements allows one to conclude that the mobility is independent of temperature. This implies the elastic scattering of the electrons at about 3×10^{19} cm^{-3} neutral impurities. Furthermore, the mean free path of the electrons for loss of a phonon at 8°K is determined to be 106 Å. (auth)

26307 CURRENT SATURATION IN IRRADIATED SYNTHETIC FUSED SILICA. Onnasch, D. (Univ., Kiel). Phys. Status Solidi; 38: 593-7(1 Apr 1970).

The γ-ray-induced current in synthetic fused silica (containing water) is saturated at field strengths $\gtrsim 1.4 \times 10^4$ V/cm caused by two effects. Besides the schubweg saturation known from photoconductors with blocking contacts, the saturation of the drift velocity of the electrons at the level of the velocity of sound is demonstrated. In some samples, especially at lower temperatures, the effect is accompanied by instabilities of the induced current explained by charge redistributions. (auth)

26308 IONIC DISPLACEMENT IN CURRENTS IN IRRADIATED ALKALI HALIDES. Fuchs, W.; Taylor, A. (Cornell Univ., Ithaca, N. Y.). Phys. Status Solidi; 38: 771-5(1 Apr 1970).

A brief theoretical discussion is given of possible ionic and electronic displacement currents associated with the random walk annealing of Br^- interstitials in KBr. Displacement current peaks were observed during isochronal annealing at 22.0, 24, and 27°K subsequent to cobalt gamma irradiation at 10°K. Only the lowest temperature peak appears to be ascribable to an ionic current due to interstitial–vacancy recombination. It is concluded that less than 1% of the Br^- interstitials in the irradiated crystals were free to participate in a random-walk annihilation process. (auth)

26309 DOPING OF AN ARGON MATRIX WITH POTASSIUM BY IRRADIATION AT 4.6°K IN A REACTOR AND AN OPTICAL ABSORPTION MEASUREMENT. Neubauer, H. J.; Press, G.; Jodl, H. J.; Hingsammer, J.; Luescher, E. (Technische Hochschule, Munich). Z. Angew. Phys.; 28: 309-12(31 Mar 1970). (In German).

Argon crystals were irradiated at 4.6°K in the Munich research reactor and thereby doped with 10^{15} potassium atoms/cm^3 via the nuclear reastion $^{40}Ar(n,\beta)^{41}K$. A procedure is described for growing argon crystals and their preparation. A measurement of the optical absorption revealed a triplet splitting of the P–S line of the potassium atom which was isolated in the argon matrix. This splitting is presumably due to a lowering of the symmetry of the crystalline field near the potassium atom. (auth)

26310 RAMAN SPECTRUM OF V_K CENTERS IN KCl: Ag CRYSTALS. Jette, A. N. (Johns Hopkins Univ., Silver Spring, Md.); Bohandy, J.; Murphy, J. C.; O'Shea, D. C.; Wilson, C. M. Phys. Lett.; 31A: 449-50(20 Apr 1970).

Raman spectra from an x-irradiated KCl: Ag crystal at 77°K is reported. A signal at 235 cm^{-1} is assigned to the V_K center on the basis of experimental and theoretical considerations. (auth)

26311 ELECTRON CHANNELING AT HIGH ENERGIES. Spring, M. S. (Cavendish Lab., Cambridge, Eng.). Phys. Lett.; 31A: 421-3(20 Apr 1970).

Many-beam dynamical theory calculations for electrons of energy up to 6 MeV are presented and the channeling behavior considered. (auth)

26312 MECHANISM OF SLIP BAND GROWTH IN IRRADIATED CRYSTALS. Makin, M. J. (Atomic Energy Research Establishment, Harwell, Eng.). Phil. Mag.; 21: 815-18(Apr 1970).

It was observed that the slip bands formed in irradiated copper crystals during deformation show an initial phase of rapid development, followed by a slower phase. It is shown that the observed characteristics can be qualitatively explained in terms of the conditions existing at the edges of a band due to (a) partial sweeping of the defect clusters and (b) the elastic stresses due to the work-hardened dislocation structure within the band. The model proposed suggests that the correct parameter to use for the "strain rate" in analyses of the thermal activation characteristics of deformation in such materials is the rate of formation of new slip bands, and not the true strain rate of the material within the bands. (auth) (UK)

26313 FIELD ION MICROSCOPE EXAMINATION OF HEAVY ION RADIATION DAMAGE IN IRIDIUM. II. ANALYSIS OF VACANCY DISTRIBUTIONS. Hudson, J. A.; Dury, B. L.; Ralph, B. (Cambridge Univ., Eng.). Phil. Mag.; 21: 779-86(Apr 1970).

Two methods are described for determining the distribution of point defects in field-ion microscope specimens from a series of micrographs. Both methods assume the micrographs to be orthographic projections of the specimen surface; the first is a manual method and the second uses a digitizer and computer. Examples are given of vacancy distributions in specimens bombarded with heavy ions at 78°K and room temperature. (auth) (UK)

26314 ESR STUDIES OF THE X-IRRADIATED NaCl CRYSTALS CONTAINING CATIONIC IMPURITIES. Nistor, S. V.; Darabont, A. (Inst. for Atomic Physics, Bucharest. Univ. of Cluj). Solid State Commun.; 8: 451-4(15 Mar 1970).

NaCl single crystals, containing cationic impurities (Fe, Ni, Ca), exhibit after x-ray irradiation an ESR spectrum from some paramagnetic centers. The lines arising from different centers were identified and their spin Hamiltonian parameters were determined. Models are proposed from which the crystal field parameters were calculated. (auth) (UK)

26315 PARAMAGNETIC RESONANCE AND OPTICAL ABSORPTION IN GAMMA-RAY IRRADIATED ALPHA QUARTZ: THE Al CENTER. Weeks, R. A. (Oak Ridge National Lab., Tenn.). J. Amer. Ceram. Soc.; 53: 176-9(21 Apr 1970).

The optical absorption spectra between 1.0 and 8.5 eV and the electron paramagnetic resonance spectra at 10 GHz of a synthetic crystal of α-quartz grown on a z plate were measured as a function of ^{60}Co γ-ray irradiation and thermal treatment. After initial irradiation, an estimate of a lower limit for the concentration of centers contributing to the resolved optical bands gave $N \gtrsim 10^{16}$ cm^{-3} for each band. An estimate of the concentration of spins of each of the distinct paramagnetic species gave $N < 3 \times 10^{15}$ cm^{-3} with the exception of the "Al" center for which $N \approx 3 \times 10^{15}$ cm^{-3}. Thermal bleaching and reirradiation of the crystal showed that the defects with bands in the 1.0- to 6.5-eV region were independent of the defects with bands in the 5.5- to 8.5-eV region and that undetected precursor defect configurations were altered by heating to form those defects whose optical bands (5.5 to 8.5 eV) increased after the second irradiation. The only correlation observed between paramagnetic defects and defects producing optical absorption bands was between the "Al" center and a band at 8.45 eV; the correlation was quite weak. (auth)

26316 POSSIBILITY OF A BOUND-NEUTRON ELECTRON STATE. Rietschel, H.; Fink, J. (Kernforschungszentrum, Karlsruhe, Ger.). Phys. Lett.; 31A: 83(26 Jan 1970).

Grant and Cobble (Phys. Rev. Lett., 23: 741(1969)) suggested that they found neutrons bound to trapped electrons in LiF crystals. Their experiment was repeated with higher flux and a ^7Li-enriched sample of larger volume. Within an error of 4.8%, their result was not confirmed. (auth)

Physical Properties

Refer also to abstract 25781.

26317 PHONON FREQUENCIES OF THE HEXAGONAL METALS Be, Mg, AND Zn. Prakash, Satya; Joshi, S. K. (Univ. of Roorkee, India). Phys. Rev., B; 1: 1468-78(15 Feb 1970).

The phonon frequencies of hexagonal metals Be, Mg, and Zn are computed using the single-orthogonalized-plane-wave electron-ion matrix element and the dielectric function due to Singwi et al. The bare-ion potential is obtained by a modified Hartree–Fock–Slater scheme. The exchange potential is determined by the Kohn–Sham approach, and the correlation corrections are included according to the prescription of Robinson et al. The calculated phonon frequencies of these metals are in good agreement with the neutron spectrometric measurements, except for Zn in the $[01\bar{1}0]$ direction. The phonon frequencies for these metals are also calculated for different c/a ratios. (auth)

26318 PERTURBED-ANGULAR-CORRELATION STUDY OF ELECTRIC-QUADRUPOLE INTERACTIONS IN ^{172}Yb IN THULIUM METAL AND OXIDE LATTICES. Rasera, R. L.; Li-Scholz, A. (Univ. of Pennsylvania, Philadelphia). Phys. Rev., B; 1: 1995-2006(1 Mar 1970).

Electric-quadrupole hyperfine interactions at ytterbium ions in thulium metal and Tm_2O_3 were investigated at 296°K using time-differential perturbed angular correlation in γ-ray cascades in ^{172}Yb. The ratio of the spectroscopic quadrupole moments of the 1174- and 79-keV states in ^{172}Yb was measured to be $Q(1174)/Q(79) = 1.33 \pm 0.15$. Using this ratio and a value for Q(79) obtained from the Coulomb-excitation transition probability, the magnitudes of the electric-field-gradient (EFG) tensors are obtained. For ytterbium in thulium metal, the measured quadrupole interaction frequencies in the respective nuclear states are found to be $\omega_0(1174) = (101 \pm 4) \times 10^6$ rad/sec, $\omega_0(79) = (190 \pm 19) \times 10^6$ rad/sec, yielding for the magnitude of the largest component of the field gradient $V_{zz} = (4.53 \pm 0.47) \times 10^{17}$ V/cm^2 at 296°K, a value not significantly different from that found at thulium nuclei in thulium metal, indicating no significant ionic contribution to the EFG. In thulium sesquioxide, the corresponding values for the C_2 site are $\omega_0(1174) = (374 \pm 30) \times 10^6$ rad/sec and $\omega_0(79) = (701 \pm 56) \times 10^6$ rad/sec, from which $V_{zz} = (1.67 \pm 0.20) \times 10^{18}$ V/cm^2. The anisotropy η expected from crystal-symmetry considerations is not observable within the experimental accuracy, and is probably small. The half-life of the 79-keV state in ^{172}Yb was measured to be 180 ± 0.05 nsec. Within the time range of the experiment, no time-dependent attenuations or aftereffects of preceding decay events were found. (auth)

26319 THEORY OF THE TEMPERATURE DEPENDENCE OF THE SPIN-WAVE EXCITATION ENERGIES IN THE RARE-EARTH METALS. Brooks, M. S. S. (Univ. of Pittsburgh). Phys. Rev., B; 1: 2257-64(1 Mar 1970).

The temperature dependence of the spin-wave excitation energies in the ferromagnetic heavy rare-earth metals, due to spin-wave interactions originating in the strong crystalline electric fields, is studied from both macroscopic and microscopic viewpoints. Consistency between an interacting spin-wave theory, linearized in the Hartree–Fock approximation, and a suitable extension of Smit's macroscopic theory is obtained. Both approaches are consistent with Kanamori and Tachiki's semiphenomenological spin-wave theory. The resonance frequency may be expressed as a geometric mean of the axial and planar anisotropy fields, provided that the low-temperature behavior of the anisotropy constants is modified to allow for elliptical spin precession. At higher temperatures, the results are consistent with Cooper's phenomenological theory. For Tb, agreement with experiment is excellent, but there is a discrepancy in the magnitude of the resonance frequency in Dy. (auth)

26320 CONDUCTIVITY ANOMALY IN VANADIUM DIOXIDE. Guntersdorfer, M. (Siemens AG, Munich). Solid-State Electron.; 13: 355-67(1970). (In German).

Some oxides of the transition metals vanadium and titanium exhibit at a critical temperature T_k a conductivity anomaly not yet explained. Because of $T_k = 338.5$°K being suitable for experimental investigations, VO_2 was used as a model substance which, as a single crystal, shows a conductivity jump of nearly 5 decades. According to the temperature dependence of the conductivity, the metallic state originates from the semiconducting state by the disappearance of an activation energy of 0.65 eV. Taking into account an ion displacement found out by x-ray investigations, the activation energy can be understood by means of a deformation potential which was quantitatively verified by the results of a piezoresistivity measurement. The high-temperature phase can be treated as a monovalent metal because of the single excess conduction electron. After undergoing the transition temperature, the resulting lattice doubling leads to splitting of the conduction band at the Fermi level. In this way, the metallic conduction changes to intrinsic semiconduction. A simple theoretical estimate is given of the deformation potential. Thermoelectric measurements and optical observations confirm the model. (auth)

26321 THERMAL EFFECT IN VO_2. Guntersdorfer, M. (Siemens AG, Munich). Solid-State Electron.; 13: 369-79(1970). (In German).

From an investigation on solid-state thermal breakdown by Schnupp it follows that, in many semiconductors, electrical switching at elevated voltage may be caused by thermal effects. These seem, however, to be inconsistent with the short switching times observed in some materials. The switching behavior was investigated experimentally and theoretically in the case of VO_2 which shows a sharp resistivity decrease at the temperature of 338.5°K caused by a transition from a semiconducting to a quasimetallic state. Although switching times as low as 40 nsec are observed, it is shown that the effect is caused by a thermal breakdown connected with the transition to the quasimetallic state. (auth)

26322 ADVANCES IN ELECTRONICS AND ELECTRON PHYSICS. VOLUME 24. Marton, L. (ed.). New York; Academic Press Inc. (1968). 299p. $14.50.

A separate abstract was prepared for one of the four chapters included. The other three chapters deal with electron spin resonance as a tool in mineralogy and geology, the electron-beam shadow method of investigating magnetic properties of crystals, and moving striations. (A.G.W.)

For an abstract of one section see: 25997.

26323 THE MAGNETIC SUSCEPTIBILITY OF SOLID SOLUTIONS OF ZIRCONIUM AND NIOBIUM MONOCARBIDES. Dubrovskaya, L. B.; Borukhovich, A. S.; Gel'd, P. V.; Matveenko, I. I.; Kudryasheva, L. V.; Ordan'yan, S. S. (Lensovet Leningrad Technological Inst.). Sov. Phys.-Solid State (Engl. Transl.); 11: 2451-3(Apr 1970).

Translated from Fiz. Tverd. Tela; 11: 3021-3(Oct 1969).

The magnetic susceptibility χ and its temperature coefficient α were measured in ZrC–NbC over the entire composition range at 20 to 1300°K. The χ reaches a minimum for $Nb_{0.10}Zr_{0.90}C$, corresponding to a valence-electron concentration of 8.1. The rigid-band model and the Fermi level are discussed briefly. (D.L.C.)

26324 THERMAL DIFFUSIVITY AND THERMAL CONDUCTIVITY OF VANADIUM AT HIGH TEMPERATURES. Zinov'ev, V. E.; Krentsis, R. P.; Gel'd, P. V. (Ural Polytechnic Inst., Sverdlovsk, USSR). Sov. Phys.-Solid State (Engl. Transl.); 11: 2475-7(Apr 1970).

Translated from Fiz. Tverd. Tela; 11: 3045-8(Oct 1969).

The thermal diffusivity of pure V was measured at 870 to 2130°K. Of the total thermal conductivity calculated from the data, the electronic component provides a substantial contribution. The formation energy of vacancies is estimated to be 2.5 eV from the lattice component. The electron scattering mechanisms responsible for the temperature dependence of the thermal conductivity are discussed. (D.L.C.)

26325 SPIN-CORRELATION EFFECTS ABOVE THE CURIE POINT AND THEIR ACTION ON NEUTRONS. Binder, K.; Rauch, H. (Oesterreichische Hochschule, Vienna). Z. Angew. Phys.; 28: 325-31(31 Mar 1970). (In German).

The spin-correlation functions are calculated by means of numerical methods. With these functions, new characteristics of the magnetic short-range order can be seen. With series expansions, one obtains additional information about the time variation of the correlations. It is shown that neutron depolarization measurements can be advantageously used for the investigation of the time dependence of the correlations. The experiment demonstrates that the short-range orders have a distinct action on the degree of polarization of the transmitted beam too. (auth)

26326 STRUCTURE AND PROPERTIES OF RF-SPUTTERED SUPERCONDUCTING TANTALUM FILMS. Schrey, F. (Hughes Aircraft Co., Culver City, Calif.); Mathis, R. D.; Payne, R. T.; Murr, L. E. Contract AT(11-1)-113. Thin Folid Films; 5: 29-40(Jan 1970).

The rf sputtering of tantalum films was studied at substrate temperatures ranging from 13 to 525°C. A bcc phase at room temperature, an fcc phase at 325°C, and an amorphous phase at 525°C were observed using electron microscopy. The resistivity was measured for the fcc and bcc phases. The superconducting transition temperature for both phases was measured. The results are compared with other deposition processes for tantalum films. (auth)

26327 STUDY OF THIN FILMS OF YTTERBIUM BY X RAYS AND ELECTRON MICROSCOPY. Boulesteix, C. (Faculte des Sciences, Orsay, France); Valiergue, L.; Gasgnier, M.; La Blanchetais, Ch. Henry. Thin Solid Films; 5: 15-28(Jan 1970). (In French).

Studies of ytterbium thin films by x-ray diffraction allow distinction of fcc, hcp, and bcc phases. The thin-film structure is greatly influenced by substrate temperature, and different metastable phases are observed as the substrate temperature is changed. Electron microscopy shows that the crystal size is also dependent upon substrate temperature. Recrystallization of ytterbium thin films was carried out above the fcd–hcp transition temperature. In this way, large hcp crystals were obtained that could be kept at ambient temperature without any recrystallization of the ytterbium thin films. (auth)

26328 DOUBLE PEAKS IN THE SPECIFIC HEATS OF ErAs AND ErSb AT LOW TEMPERATURES. Hovi, V.; Lehtinen, M.; Vuola, R. (Univ. of Turku, Finland). Phys. Lett.; 31A: 451-2 (20 Apr 1970).

The specific heats of ErAs and ErSb were measured at liquid helium temperatures. It was found that these compounds have double peaks in their specific heats. (auth)

26329 INTERNAL FIELDS FOR Cd IN GADOLINIUM METAL. Bostroem, L.; Jonsson, B.; Karlsson, E.; Liljegren, G.; Zetterlund, S. (Uppsala Univ.). Phys. Lett.; 31A: 436-7(20 Apr 1970).

The magnetic field at Cd nuclei in ferromagnetic Gd was determined to be −312 ± 10 kG at 78°K using the DPAC method. The experimental data are compared with a theoretical curve for noncolinear magnetic and electric fields. (auth)

26330 ISOTOPE INTER-DIFFUSION AND SELF-DIFFUSION IN SOLID LITHIUM METAL. Lodding, A.; Mundy, J. N.; Ott, A. (Chalmers Univ. of Tech., Gothenburg, Sweden). Phys. Status Solidi; 38: 559-69(1 Apr 1970).

The inter-diffusion of Li isotopes in separated ^7Li and ^6Li metals was measured in the temperature range 35 to 178°C. The results can be expressed as $^7D_6 = (0.120 \pm 0.020) \exp(-12.634 \pm 0.139/RT)$ and $^6D_7 = (0.123 \pm 0.030) \exp(-12.848 \pm 0.222/RT)$ cm^2/sec, where $^7D_6$ denotes the diffusion of ^6Li tracer in pure ^7Li metal, and vice versa. The $^7D_6$-values exceed $^6D_7$ by about 23% at the melting point and by about 37% at 0.7 T_m (°K). There are indications that the striking isotope effect may be due to tunneling. Tunneling considerations founded on a square barrier approximation suggest a dumbbell interstitial mechanism as a likely self-diffusion model for lithium. According to the calculation for the dumbbell, the contribution from the tunneling process to the effective activation energy of self-diffusion is of the same order as, or smaller than, the potential barrier to activated motion. Without favoring any particular diffusion model, the following expressions can be computed for uncorrelated self-diffusion in isotopically pure lithium metals: $^7D_7 = (0.14 \pm 0.07) \exp(-12.87 \pm 0.18/RT)$ and $^6D_6 = (0.14 \pm 0.08) \exp(-12.60 \pm 0.25/RT)$ (diffusion coefficients in cm^2/sec, energies in kcal/mol). (auth)

26331 DISLOCATION MOTION IN SECONDARY SLIP PLANES IN ALKALI HALIDE CRYSTALS AT ROOM TEMPERATURE. Gutmanas, E. Yu.; Nadgornyi, E. M. (Solid State Physics Inst., Chernogolovka, USSR). Phys. Status Solidi; 38: 777-82(1 Apr 1970).

Dislocation motion in $\{100\}\langle 110\rangle$ and $\{111\}\langle 110\rangle$ secondary slip systems was observed in LiF, NaCl, KCl, KBr, KI, and RbI crystals at room temperature by means of a special loading and etch-pit technique. The observed reduction in the difference between the critical resolved shear stress $\tau_{s\{110\}}$ in the primary slip system $\{110\}\langle 110\rangle$ and τ_s in the secondary slip system in the above sequence of crystals demonstrates the increasing influence of multiplication processes of dislocations on dislocation motion in the primary system. A considerably lower effect of γ irradiation on $\tau_{s\{100\}}$ and $\tau_{s\{111\}}$ was found in comparison with that of $\tau_{s\{110\}}$. Possible reasons are discussed briefly. (auth)

26332 ANISOTROPY OF PLASMA OSCILLATIONS IN BORON NITRIDES. APPLICATION TO THE DETERMINATION OF THE INTERBAND TRANSITIONS. Cazaux, Jacques (College de France, Paris). Compt. Rend., Ser. B; 270: 700-3(2 Mar 1970). (In French).

The study of the characteristic energy losses at small scattering angles reveals an anisotropy of these losses similar to that observed in graphite. The analysis of the experimental results allows the interband transitions of the valence electrons to be determined. (France)

26333 MICROWAVE MAGNETIC ABSORPTION AND DISPERSION MEASUREMENTS, AT 9.3 GHz, IN SOME CONDUCTING INTERMETALLIC COMPOUNDS. Lancia, R.; Marchand, A.; Coumes, A. (Centre National de la Recherche Scientifique, Grenoble, France). J. Phys. (Paris); 31: 109-11(Jan 1970). (In French).

For intermetallic compounds whose resistivity is not infinite, it is necessary to know the imaginary part μ'' of the high-frequency permeability in order to determine both the real and imaginary parts, μ_L and μ_R, of the effective permeability. A microwave equipment for the measurement of μ_L and μ_R is described and results for $NdCo_5$ are given. (France)

26334 NEUTRON-DIFFRACTION STUDY OF THE MAGNETIC STRUCTURE OF Er_3Co AND Er_3Ni. Gignoux, D.; Lemaire, R.; Paccard, D. (CNRS, Grenoble, France). Solid State Commun.; 8: 391-400(15 Mar 1970). (In French).

Er_3Co and Er_3Ni have the same crystal structure but different magnetic behavior, the former exhibiting spontaneous magnetization below 7°K but the latter being metamagnetic. Their magnetic structures are non-collinear and many symmetry elements are lost, the groups being Pn'ma' and $Pc\bar{1}$ respectively. The stability of these structures is due to a highly anisotropic exchange between erbium atoms bonded by conduction electrons. (UK)

26335 ELECTRONIC PROPERTIES OF TITANIUM AND ZIRCONIUM HYDRIDES. Ducastelle, F.; Caudron, R.; Costa, P. (Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux, France). J. Phys. (Paris); 31: 57-64(Jan 1970). (In French).

The electronic specific heat, the magnetic susceptibility, and the thermoelectric power of compounds of the Ti–H and Zr–H systems with high hydrogen content were measured. The results are consistent with the presence of a high-density d-character narrow band at the Fermi level. Moreover, they show a strong dependence of the electronic properties on crystal structure, which can be attributed to a Jahn–Teller type effect, the deformation of the density of states distribution N(E) leading to a lower total energy of the quadratic phase for high hydrogen contents. A rough model of these band deformations is proposed for both systems. (France)

Moessbauer Effects and NMR

26336 NUCLEAR MAGNETIC RESONANCE IN URANIUM HYDRIDE AND DEUTERIDE. Grunzweig-Genossar, J.; Kuznietz, Moshe; Meerovici, Balfour (Technion-Israel Inst. of Tech., Haifa). Phys. Rev., B; 1: 1958-77(1 Mar 1970).

β-uranium-hydride and β-uranium-deuteride are ferromagnetic with Curie temperatures of 182 and 178°K, respectively. Nuclear-magnetic-resonance studies of the proton in $\beta-UH_3$, and of the deuteron in $\beta-UD_3$, were made in the paramagnetic state of these compounds. The measured hydrogen Knight shifts (K) in $\beta-UH_3$ and $\beta-UD_3$ are given by $K = (0.40 \pm 0.03)\chi_M$, where χ_M is the molar susceptibility. The second moments are determined as $M_2 = (24 \pm 2) + (45 \pm 3) \times 10^{-4} h^2\ Oe^2$ in $\beta-UH_3$, and $M_2 = (56.4 \pm 1.5) + (48.5 \pm 3) \times 10^{-4} h^2\ Oe^2$ in $\beta-UD_3$, where $h = H_0/T-\theta)$, θ being the appropriate paramagnetic Curie temperature. Analysis of the linewidth, line shape, and second moment showed that there are three line-broadening mechanisms (four in the deuteride): internuclear dipolar broadening, the (classical) dipolar field of the 5f electrons on the uranium ions, and an effect due to the use of powder samples (in the deuteride, a quadrupolar interaction is also present, with $|e^2qQ/h| = 14.5 \pm 0.5$ kHz). The line shapes, due to the simultaneous presence of several broadening mechanisms, are discussed in some detail. The 5f electrons are shown to be localized and do not form a band. The ferromagnetic interaction was analyzed using a simple Ruderman–Kittel–Kasuya–Yosida model, from which it is deduced that the coupling constant $\Gamma \sim 20$ eV $Å^3$, $m^*/m_e \sim 3$, and the concentration of conduction electrons is about 2.5 per uranium ion. The Knight shift and quadrupole shielding were calculated, assuming the presence of a high-density interacting electron gas. At temperatures above 370°K, line narrowing was observed, from which the activation energy for hydrogen diffusion was obtained as E = 8.4 ± 0.9 kcal/mole for the hydride and 8.9 ± 0.9 kcal/mole for the deuteride. It was concluded, on the basis of the pre-exponential term τ_0 of the correlation time τ_c, that diffusion takes place by a vacancy mechanism, and that the higher values of τ_0 and τ_c for the deuterium are mainly due to a difference in the relaxation mechansim. The valency of the uranium ions present has not been definitely established; they are either U^{3+} or U^{4+}, probably the latter. (auth)

26337 THEORY OF MAGNETIC MOESSBAUER DIFFRACTION MEASUREMENT. Belyakov, V. A.; Aivazyan, Y. M. (All Union Inst. of Physical-Technical and Radio-Technical Measurements, Moscow). Phys. Rev., B; 1: 1903-7(1 Mar 1970).

The theory of Moessbauer γ-ray diffraction by magnetically ordered crystals containing Moessbauer nuclei is developed in the Born approximation. It is shown that for crystals whose magnetic structure induces an ordering of magnetic fields at Moessbauer nuclei, the diffraction patterns exhibit magnetic Bragg maxima. The positions of these maxima do not coincide generally with the positions of Rayleigh maxima. The polarization of radiation scattered at Bragg angles contains information about the orientation of the magnetic fields at the Moessbauer nuclei relative to the crystallographic directions. The expressions for the polarization and coherent scattering cross section are given in the case of large nuclear Zeeman splitting for a purely nuclear scattering. Diffraction by antiferromagnetic crystals is examined in detail. The possibility of studying magnetic ordering in crystals by means of Moessbauer diffraction is discussed. (auth)

26338 ENDOR INVESTIGATIONS ON INTERSTITIAL HYDROGEN AND DEUTERIUM ATOMS IN SrF_2 CRYSTALS. Boettcher, R.; Frieser, A.; Milsch, B.; Voelkel, G.; Wartewig, S.; Welter, M.; Windsch, W. (Karl Marx Univ., Leipzig). Phys. Status Solidi; 38: K97-100(1 Apr 1970).

The ENDOR spectra of x-irradiated $SrF_2:H$ and $SrF_2:D$ crystals were measured at 77 and 4.2°K to determine the dependence of the hyperfine constants of nuclei in several shells on the lattice constant. The isotropic and anisotropic parts of the hfs constants and coupling constants were calculated for the [100] and [110] directions. The intensity of the ENDOR signals increases with H_1^2 at low microwave power and decreases with H_1^{-1} at high power. (D.L.C.)

26339 FREQUENCY MODULATION METHOD FOR PERFORMING ADIABATIC DEMAGNETIZATION IN THE ROTATING REFERENCE FRAME. Samuelson, Gary L.; Ailion, David C. (Univ. of Utah, Salt Lake City). Rev. Sci. Instrum.; 41: 743-5 (May 1970).

A new method for performing adiabatic demagnetization in the rotating reference frame in NMR experiments is presented. In this new method the frequency of a crystal oscillator rather than the actual magnetic field is pulsed off resonance. Using simple circuits which are described, the effective field in the rotating frame can be pulsed by as much as 50 G, depending on the nucleus studied. This method completely avoids the problem of external magnetic field correction due to a pulsed field in the magnetic gap. (auth)

26340 MOESSBAUER STUDY OF THE FOUR COMPOUNDS OF IRON WITH THORIUM. Blow, S. (Atomic Energy Research Establishment, Harwell, Eng.). J. Phys., C (London); 3: 158-71 (Jan 1970).

There are four compounds of iron with thorium, namely Th_7Fe_3, $ThFe_3$, $ThFe_5$, and Th_2Fe_{17}. The spectra of Th_7Fe_3 did not display magnetic splitting; the quadrupole splitting and isomeric shift values at liquid helium temperature were 0.054 cm sec^{-1} and +0.018 cm sec^{-1} respectively, the values at room temperature being 0.048 cm sec^{-1} and +0.002 cm sec^{-1}. All isomeric shift values are relative to sodium nitroprusside at zero velocity. $ThFe_3$, $ThFe_5$, and Th_2Fe_{17} all exhibit magnetic splitting in their Moessbauer spectra, though the type of magnetic condensation in $ThFe_5$ and Th_2Fe_{17} is not established. It was possible to make an analysis of the energy splittings for iron atoms at positions of high symmetry. In $ThFe_3$, the α-sites of high symmetry can be distinguished from the β-sites of low symmetry. At 20°K, the hyperfine field and quadrupole splitting values at the former site were 199 ± 5 kG and 0.06 cm sec^{-1} respectively; at the β-site the magnetic field had the value 243 ± 5 kG. For $ThFe_5$, the spectra consist of two six-line contributions. At the high-symmetry site, the hyperfine field was estimated to be 277 ± 7 kG at 20°K, and the value was the same, within experimental error, at the low-symmetry site. All the iron atom sites in Th_2Fe_{17} have low symmetry and the spectra are complex. It has been estimated, however, that at 20°K the hyperfine field is 271 ± 10 kG — the same as for $ThFe_5$ within experimental error. (auth) (UK)

26341 NUCLEAR MAGNETIC RESONANCE IN Y–Ce ALLOYS. Silhouette, D. (CNRS, Orsay, France). Solid State Commun.; 8: 467-71(15 Mar 1970).

NMR results of ^{89}Y in Y–Ce Kondo alloy are reported. The linewidth is quite insensitive to cerium addition up to a concentration of approximately 0.5%. For higher concentrations, the temperature dependence of the linewidth depends markedly on the concentration. Besides the main line, a satellite appears with a Knight shift of 0.07% (±0.02). At 20°K, its relative intensity goes through a maximum for a concentration between 0.5 and 1%, suggesting a short-range interaction between Ce impurities. No definite variation of the Knight shift of both lines could be observed in the temperature range studied from 1.8 to 77°K. (auth) (UK)

Theoretical Physics

Refer also to abstracts 26131, 26397, 26452, 26454, 26456, 26458, 26459, 26488, and 26515.

26342 (ITF-69-67) METHOD OF THE GENERATING FUNCTIONAL IN THE KINETICS OF THE WEAK NONUNIFORM STATES. Krasil'nikov, V. V.; Tsukanov, V. D. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1969. 25p. (In Russian). Dep. CFSTI (U. S. Sales Only).

The generating functional of mean values of the creation and annihilation operators of particles is introduced for the investigation of the kinetics of the weak nonuniform states. The functional equation for this functional is formulated substituting the Liouville equation for the density matrix. The integral equations for the first two terms of the generating functional expansion in gradient series are found for that stage of the evolution when the state of the system can be described by the single-particle density matrix. The integral equation for the hydrodynamic generating functional is obtained as well, and a solution of this equation in the first approximation by the density of particles of the system is found. By means of this solution, the kinetic equation for the linear distribution function was obtained by gradient approximation. (auth)

26343 MANY-BODY POINT TRANSFORMS. Witriol, Norman M. (Brandeis Univ., Waltham, Mass.). J. Math. Phys. (N. Y.); 11: 669-80(Feb 1970).

The method of point transforms is extended to the consideration of the truly many-body terms of many-body systems. The point transformation is taken to be regional (one body isolated, two bodies interacting, three bodies interacting, · · ·, N bodies interacting) and continuous in the 3N-dimensional transformed space. The transformed Hamiltonian and wavefunction of an N-body system can then be easily approximated by one-body, two-body, three-body, · · ·, or N-body additivity. As an example of the use of this method, a set of regional point transforms is developed for the short range, strongly repulsive, or hard-core many-body problem. Applying these transforms to the many-body Hamiltonian, a set of equivalent Hermitian Hamiltonians were obtained which are Fourier analyzable and amenable to ordinary perturbation and variational techniques. Assuming two-body additivity, this set is shown to be the set of pairwise point transformations developed by Eger and Gross. (auth)

26344 DIRAC ELECTRON IN ORTHOGONAL ELECTRIC AND MAGNETIC FIELDS. Lam, L. (Columbia Univ., New York). Lett. Nuovo Cim.; 3: 292-4(26 Feb 1970).

Earlier solutions (V. Canuto and C. Chiuderi: Lett. Nuovo Cimento, 2, 223(1969)) to the problem are critized and a new derivation is given. (M.O.W.)

26345 FUNCTIONAL RANDOM-WALK MODEL OF THE MANY-PARTICLE SYSTEM. Hosokawa, Iwao (Goddard Space Flight Center, Greenbelt, Md.). J. Math. Phys. (N. Y.); 11: 657-66(Feb 1970).

By Fourier-transforming the author's recently proposed state functional formalism for the BBGKY hierarchy, a new perspective of nonequilibrium statistical mechanics is given; the basic equation is formally very close to the Fokker–Planck equation and may readily be modified to a universal master equation (with irreversibility) by a slight change. Hence, the problem reduces to one of a generalized random-walk such that the stochastic quantity to be considered is the particle-number density in the 1-body phase space. A general solution is formulated for the weak interaction case. (auth)

26346 GENERALIZED QUANTUM THEORY. Collins, R. E. (Univ. of Houston, Tex.). Phys. Rev., D; 1: 379-89(15 Jan 1970).

Beginning with the definition of a duplicated experiment and the fact that the resulting data are summarized as a set of configurations of some observables, together with frequencies of occurrence of each configuration, formal structure of conventional quantum theory is derived, using only the statistical properties of such data, and it is shown that certain elements of the theory have heretofore been overlooked. This derivation yields a rather broad generalization of the theory, which suggests new methods for describing phase transitions and possibly fundamental particles as well. (auth)

26347 EFFECTS OF A MAGNETIC GUIDE FIELD ON THE PROPAGATION OF INTENSE RELATIVISTIC ELECTRON BEAMS. Andrews, M.; Bzura, J.; Fleischmann, H. H.; Rostoker, N. (Cornell Univ., Ithaca, N. Y.). Phys. Fluids; 13: 1322-7 (May 1970).

In the absence of a magnetic guide field, intense relativistic electron beams will not propagate because the electrostatic repulsive forces always dominate the magnetic pinching forces. It is necessary to have some background ions to reduce the space charge of the beam. With a sufficiently strong magnetic guide field in the direction of propagation, it is, in principle, possible to have an equilibrium with no ions. The theoretical basis for un-neutralized propagation and beam focusing is presented. Experiments were carried out that indicate qualitative changes in beam propagation and focusing with a guide field. (auth)

26348 PAIR OCCUPATION, FERMI CONDENSATION, AND PHASE TRANSITIONS IN MANY-FERMION SYSTEMS. Girardeau, M. D. (Univ. of Oregon, Eugene). J. Math. Phys. (N. Y.); 11: 684-98(Feb 1970).

For a system of 2n fermions it is shown that the occupation number n_α of any fermion-pair state $\varphi_\alpha(x_1x_2)$ is $n_\alpha = n \int \varphi_\alpha^*(x_1x_2) \rho_2(x_1x_2, x_1'x_2') \varphi_\alpha(x_1'x_2') dx_1dx_2dx_1'dx_2'$, where ρ_2, assumed normalized to unity, is the two-particle density matrix. The known upper bound on the largest eigenvalue of ρ_2 implies that $n_\alpha \le 1/2$ in the thermodynamic limit $n \to \infty$, equality being approached, with suitable φ_α, only for certain limiting BCS states ψ_{BCS}. Bose condensation of fermion pairs, in the sense of macroscopic occupation of any n_α, is impossible. Fermi condensation into φ_α is defined to be present if $n_\alpha > 0$ in the thermodynamic limit. It occurs, for example, for suitable BCS states, but for a normal Fermi system all n_α are of order n^{-1} or smaller. It is argued that the physical criterion for ψ_{BCS} exhibiting Fermi condensation is that the pair state from which it is constructed must have a bound-state component of range $\lesssim k_F^{-1}$, where k_F is the Fermi momentum $(3\pi^2\rho)^{1/3}$. The maximally occupied pair state is the eigenfunction of ρ_2 belonging to the largest eigenvalue, associated with off-diagonal long-range order of the type defined by Yang. A formula for n_1 for the original BCS state is derived. Some remarks are made concerning the interpretation of the Fermi condensation as a superconducting transition. The analysis is generalized to occupation of l-fermion states. It is conjectured that, when Fermi condensation first sets in at a given even l, this is associated with the formation of bound states of l fermions, and a formula for the maximal occupation of such states is exhibited. The implications, for the theory of liquid ^4He, of the fact that a helium atom contains electrons are examined. It is shown that Bose condensation into a single-^4He-atom state is impossible, but a Fermi condensation similar in some respects to that in a superconductor can and probably does occur. It is argued that the mechanism preventing Bose condensation in superconductors and liquid ^4He lies in the effect of collisions, acting via the exclusion principle, in causing virtual internal excitations. (auth)

26349 PARASTOCHASTICS. Frisch, U. (Institut d'Astrophysique, Paris); Bourret, R. Contract AF19(628)3868. J. Math. Phys. (N. Y.); 11: 364-90(Feb 1970).

The generalized commutation relations $A_iB_j - \lambda B_jA_i = \Gamma_{ij}I$ are introduced, where A_i and B_i are adjoint of each other, I is the identity, and Γ_{ij} is a real covariance. For $\lambda = +1$ (−1, or 0, respectively) the parastochastic function $A_i + B_i$ is given an interpretation in terms of Gaussian random functions (a two-valued stationary Markov process, or infinite symmetric random matrices of the type considered by Wigner in connection with energy levels of heavy nuclei, respectively). In the Fock-space realization, A_i and B_i appear as destruction and creation operators for bosons (fermions or boltzmannons, i.e., distinguishable particles, respectively). A few purely algebraic theorems are proved, which are applied to linear stochastic equations (equations with random coefficients). Existence and uniqueness being presupposed, mean Green's functions are shown to satisfy closed master equations. A linear functional differential master equation is obtained for equations with Gaussian coefficients. It is shown that the often-used first cumulant-discard closure assumption, which leads to a very simple master equation, is exact for differential equations with a two-valued stationary Markovian coefficient. A parastochastic reformulation of the theory of Kraichnan is given, and his nonlinear master equations are, for the first time, rigorously derived without any recourse to perturbation theory or to diagrams. Kraichnan's random-coupling model is obtained by replacing scalar stochastic quantities by Wigner matrices or, equivalently, bosons by boltzmannons (i.e., changing λ from +1 to 0). Finally, the nonlinear Kraichnan equation, $dy(t)/dt = -\int_0^t y(t-t')\ \Gamma(t-t')\ y(t')\ dt'$, is reduced to a linear parastochastic equation in the Fock space; existence, uniqueness, boundedness, and asymptotic behavior are obtained. (auth)

26350 MATHEMATICAL DESCRIPTION OF A SYSTEM CONSISTING OF IDENTICAL QUANTUM-MECHANICAL PARTICLES. Kummer, H. (Queen's Univ., Kingston, Ont.). J. Math. Phys. (N. Y.); 11: 449-74(Feb 1970).

A rigorous description of a system consisting of identical particles is given for which the particle number is a superselection rule. A state of such a system is described by a sequence of density operators $D = (D^0, D^1, \ldots, D^n, \ldots)$, where D^n acts in n-particle space and the asymptotic behavior is determined by the requirement $\Sigma_{n=0}^{\infty} k^n|D^n| < \infty$ for all $k = 1,2, \ldots$, where $||$ denotes the trace norm. The (bounded) observables in turn are described by sequences of bounded self-adjoint operators: $B = (B^0, B^1, \ldots, B^n, \ldots)$ such that $\sup_n k^{-n} ||B^n|| < \infty$ for some $k = 1,2, \ldots$. The expectation value of the observable B in the state D can be expressed as $\langle B\rangle_D = (\Gamma(B)|D) = (B|L(D))$, where $(B|D) = \Sigma_{n=0}^{\infty} \mathrm{Tr}\,(B^nD^n)$; Γ denotes the expansion operator, whereas L stands for its adjoint, the contraction operator. The analog to the n-representability problem, i.e., the so-called representability problem, is put forward and its solution is connected with the solutions of the n-representability problem for different n. Finally, a possible mathematical foundation of the BCS theory is given. (auth)

26351 NOTE ON THE BOUNDS AND APPROXIMATIONS TO THE GROUND STATE ENERGY OF N-FERMION SYSTEMS DERIVED FROM DENSITY MATRIX THEORY. Peat, F. D. (National Research Council of Canada, Ottawa). Can. J. Phys.; 48: 147-9(15 Jan 1970). (NRCC-11005).

Certain lower bounds to the ground state energy of N-fermion systems have been derived in the literature using the properties of reduced density matrices. It is indicated that while some good approximations to the energy may be obtained by similar consideration the rigorous lower bound expressions lie too far below the exact energy to prove generally useful. (auth) (Canada)

26352 QUANTUM STOCHASTIC PROCESSES. Garczynski, W. (Wroclaw Univ.). Bull. Acad. Pol. Sci., Ser. Sci. Math. Astron. Phys.; 17: 775-9(1969).

The urgent need to develop a mathematical theory of what is called quantum Markovian processes is stressed. A general idea of what they are is presented here, while the concrete simplest examples of them have recently been treated by the author in other articles. Detailed exposition of results quoted here will be given elsewhere. (auth) (TSS)

PHYSICS (HIGH ENERGY)

Particle Interactions and Properties (Experimental)

26353 (COO-1195-183) ANNUAL PROGRESS REPORT [ON ELEMENTARY PARTICLE PHYSICS RESEARCH], APRIL 1970. (Illinois Univ., Urbana. Dept. of Physics). Contract AT(11-1)-1195. 29p. Dep. CFSTI.

Research on high-energy physics experiments at the University of Illinois for the year ending April 1970 is reported. Abstracts of both bubble and spark chamber experiments are given for research completed, in progress, and planned for the future. A list of publications is also included. (J.F.P.)

26354 (UCSB-34-P-135-12) HIGH ENERGY USER GROUP AT SANTA BARBARA. Progress Report, May 1969–March 1970. Caldwell, David O. (California Univ., Santa Barbara. Dept. of Physics). Contract AT(11-1)-34. 13p. Dep. CFSTI.

Research on high-energy physics experiments by the Santa Barbara users Group is reported for the period from May 1969 to March 1970. (J.F.P.)

26355 EVIDENCE OF A QUARK IN A HIGH-ENERGY COSMIC-RAY BUBBLE-CHAMBER PICTURE. Chu, W. T. (Ohio State Univ., Columbus); Kim, Young S.; Beam, W. J.; Kwak, Nowhan. Phys. Rev. Lett.; 24: 917-23(20 Apr 1970).

A bubble-chamber picture was found which shows three contemporaneous high-energy cosmic-ray tracks. One of the tracks has ionization which is that expected of a charge-⅔ particle if the mass of this particle is less than 6.5 GeV. The observed ionization is also consistent with that which is expected of a charge-⅓ particle with a mass of 8.0 ± 3.0 GeV. (auth)

Electromagnetic

Refer also to abstract 26405.

26356 (DESY-70/1) SINGLE PHOTOPRODUCTION OF NEUTRAL π-MESONS ON HYDROGEN IN THE EXTREME FORWARD DIRECTION AT 4 AND 5.8 GeV. Braunschweig, M.; Braunschweig, W.; Husmann, D.; Luebelsmeyer, K.; Schmitz, D. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany). Bonn Univ. (West Germany). Physikalisches Institut. Kernforschungsanlage, Juelich (West Germany)). Jan 1970. 35p. Dep. CFSTI (U.S. Sales Only).

The differential cross section of the reaction $\gamma + p \rightarrow p + \pi^0$ was measured at the Deutsches Elektronen-Synchrotron DESY, Hamburg, at mean photon energies of 4.0 and 5.8 GeV for pion center of mass angles between 0° and 5° in steps of 1°. The production near 0° is dominated by the Primakoff effect. (auth)

26357 (INSJ-115) PHOTOPRODUCTION OF K^+-MESONS FROM HYDROGEN BELOW 1.2 GeV. Iwata, Seigi (Tokyo Univ. (Japan). Inst. for Nuclear Study). 13 Mar 1970. 82p. Dep. CFSTI (U. S. Sales Only).

In order to study the resonant behavior of the $K^+\Lambda^0$ state around a total energy of 1700 MeV, differential cross sections for the reaction $\gamma + p \rightarrow K^+ + \Lambda^0$ were measured along with the polarization of Λ^0-hyperons at c.m. angles around 45°, 70°, and 90° for each of the laboratory photon energies ranging from 1000 to 1170 MeV, resulting in 18 cross sections. At 1180 MeV, two differential cross sections were also obtained for the reaction $\gamma + p \rightarrow K^+ + \Sigma^0$. K^+-mesons were momentum analyzed with a sector magnet and successfully identified on the basis of their time-of-flights and energy losses. Copious pions were rejected by two Lucite Čerenkov counters of total reflection type. The data were taken on line with a small computer and stored on microtapes for the off-line analysis. The differential cross sections were fitted well with only s- and p-waves as already seen in the existing data, indicating no hint of the resonant behavior of a particular partial wave. The insignificance of the contribution from the F_{15}(1688) resonance was seen directly from the angular dependence of the polarization. The triangular relation predicted from SU(3) symmetry between photoproduction cross sections for $K^+\Lambda^0$, $K^+\Sigma^0$, and π^+n was found to be violated at all angles when evaluated at the same Q-value. (auth)

26358 π^- PHOTOPRODUCTION FROM DEUTERIUM AT LABORATORY ENERGIES 600 TO 1250 MeV. Scheffler, P. E.; Walden, P. L. (California Inst. of Tech., Pasadena). Phys. Rev. Lett.; 24: 952-4(27 Apr 1970).

The differential cross section for the reaction $\gamma + n \rightarrow \pi^- + p$ was measured for laboratory photon energies between 600 and 1250 MeV, using a liquid deuterium target. The internal nucleon momentum distribution of the deuteron was used to calculate the major effect of using deuterium as a neutron target. The data show that the amplitude to excite the F_{15}(1688) resonance is small, in agreement with a recent quark-model prediction. (auth)

26359 REACTION $\gamma p \rightarrow p\rho^0$ WITH LINEARLY POLARIZED PHOTONS AT 2.8 AND 4.7 GeV: CROSS SECTIONS AND THE ρ^0 MASS SHIFT. Bingham, H. H. (Univ. of California, Berkeley); Fretter, W. B.; Moffeit, K. C.; (and others). Phys. Rev. Lett.; 24: 955-9(27 Apr 1970).

Rho photoproduction is studied at 2.8 and 4.7 GeV using a linearly polarized photon beam in a hydrogen bubble chamber. The dependence of the ρ^0 mass shape on the momentum transfer is inconsistent with the Ross-Stodolsky factor. The production of $\pi^+\pi^-$ pairs in the s-channel c.m. helicity-conserving p-wave state accounts for almost all events in the ρ region. Evidence is presented for an interference of ρ^0 production with background. The data are compared with the Söding model and total and differential cross sections for ρ^0 production are presented. (auth)

26360 CONSERVATION OF s-CHANNEL HELICITY IN ρ^0 PHOTOPRODUCTION. Ballam, J. (Stanford Linear Accelerator Center, Calif.); Chadwick, G. B.; Gearhart, R.; (and others). Phys. Rev. Lett.; 24: 960-3(27 Apr 1970).

An analysis was made of the decay angular distribution of rho mesons produced via $\gamma p \rightarrow p\rho^0$ by linearly polarized photons at 2.8 and 4.7 GeV. The reaction proceeds almost completely through natural-parity exchange, the contribution from unnatural-parity exchange for momentum transfers $|t| < 1$ GeV^2 being (3.1 ± 2.2)% at 2.8 GeV and (−1.1 ± 1.9)% at 4.7 GeV. The behavior of the density-matrix elements shows that the rho-production mechanism conserves s-channel c.m. system helicity for $|t| < 0.4$ GeV^2. (auth)

26361 COMPTON SCATTERING BY BOUND ELECTRONS. East, L. V. (Kirtland Air Force Base, N. Mex.); Lewis, E. R. Physica; 44: 595-613(3 Nov 1969).

The differential cross section for the inelastic scattering of 662-keV photons by K-shell electrons in tantalum, platinum, and gold was experimentally determined. Ge(Li) detectors were used to detect scattered photons in coincidence with K x rays. The results of the experiment confirm earlier results, showing that the differential cross section approaches zero as the scattering angle decreases to zero, and becomes larger than the Klein–Nishina cross section for scattering angles greater than about 50°. In addition, the spectra of the inelastically scattered photons were found to be peaked near the Compton energy, with a high-energy tail extending to 662 keV less the binding energy of the struck electron. This result is in disagreement with a previously reported experiment. (auth)

26362 MEASUREMENTS ON CLOUD CHAMBER TRACKS. Wilson, J. G. (Univ. of Leeds, Eng.). Nature (London); 225: 1238-9(28 Mar 1970).

It is stated that tracks in cloud chamber photographs of particles near the axis of extensive air showers, from recent studies made in Sydney, might be interpreted in terms of particles of subunit charge. It is important, however, to examine the conditions under which normal tracks might possess the reported features; the present communication draws attention to some specific effects. The discussion is concerned with features which do not appear to exclude the possibility of the tracks being normal. The most difficult characteristic of the data to relate to normal tracks is the relative lack of delta rays. This should not be sensitive to the nature and energy of the initiating particle, but should depend strongly on its charge. Sufficient delta-ray counts might be possible to establish whether or not the number counted on tracks such as those published from the Sydney work, can possibly lie in the tail of a general distribution. (UK)

26363 PRODUCTION OF SINGLE NEGATIVE PIONS FROM DEUTERIUM WITH POLARIZED PHOTONS. Bar-Yam, Z.; de Pagter, J.; Dowd, J.; Kern, W. (Southeastern Massachusetts Univ., North Dartmouth). Phys. Rev. Lett.; 24: 1078-81(11 May 1970).

The asymmetry $A = (d\sigma_{\perp} - d\sigma_{||})/(d\sigma_{\perp} + d\sigma_{||})$ of the differential cross section for the reaction $\gamma d \rightarrow \pi^- pp$ was studied with linearly polarized photons of 3.0 GeV at squared four-momentum-transfers between 0.15 and 2.0 (GeV/c)^2. The asymmetry was found to be positive at $-t$ values below 0.3 (GeV/c)^2, dipping to negative values between 0.4 and 0.6 $(GeV/c)^2$, and then rising again to positive values above 0.7 $(GeV/c)^2$. (auth)

26364 FURTHER INFORMATION ON THE CHERENKOV TEMPORAL STRUCTURE OF E.A.S. Bosia, G.; Castagnoli, C.; Marangoni, G.; Navarra, G.; Saavedra, O. (Univ., Turin). Lett. Nuovo Cim.; 3: 373-9(14 Mar 1970).

An experimental study is made of the temporal structure of Cherenkov flashes associated with EAS. It is found that this temporal structure is more complex than previously observed. Mirrors and photomultipliers were used in this study. (J.F.P.)

26365 PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON LOW AND INTERMEDIATE ENERGY ELECTROMAGNETIC INTERACTIONS, DUBNA, USSR, FEBRUARY 7–15, 1967. VOLUME 3. Moscow; Academy of Sciences of the USSR (1967). 432p. (In Russian and English). (CONF-670203-(Vol.3)).

Eighteen papers are included on low- and intermediate-energy electromagnetic interactions. Electroproduction of mesons, elastic and inelastic electron scattering on nucleons and nuclei, elastic form factors of nucleons and nuclei, inelastic electron scattering, the (e,e′p) reactions are described. Results, implications, and relations between the cross sections for nuclear photo- and electrodisintegrations are discussed. Photodisintegration of few-nucleon systems, photodisintegration of light nuclei, direct and inverse photoeffect of medium and heavy nuclei, the theory of finite Fermi systems and nuclear photoeffect are covered. The shell theory of the nuclear photoeffect, collective models of giant multipole resonances and peculiarities of dipole absorption of γ quanta by the nonmagic light nuclei are treated. Data on analog states of nuclei and photonuclear effects, sum rules for photonuclear effects, sum rules for photonuclear reactions, optical anisotropy of atomic nuclei and nuclear decay are included. (R.V.J.)

26366 PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON LOW AND INTERMEDIATE ENERGY ELECTROMAGNETIC INTERACTIONS, DUBNA, USSR, FEBRUARY 7–15, 1967. VOLUME 2. Moscow; Academy of Sciences of the USSR (1967). 215p. (In Russian and English). (CONF-670203-(Vol.2)).

The nine papers in this volume cover the nucleon Compton effect and meson photoproduction on nucleons and nuclei. Included are the proton Compton effect, pion photoproduction below 1 GeV, pion photoproduction by polarized γ rays, the photoproduction of charged mesons near threshold, and neutral pion photoproduction on protons, photoproduction of π mesons in nuclei, the photoproduction of π^0 mesons on deuterium and helium, the photoproduction of mesons below 1 GeV, and nucleon polarization in photoreactions. (J.F.P.)

Weak

Refer also to abstract 25299.

26367 (BNL-14470) PROGRESS REPORT ON THE BROOKHAVEN SOLAR NEUTRINO EXPERIMENT. Davis, Raymond Jr. (Brookhaven National Lab., Upton, N. Y.). [1969]. 7p. (CONF-690814-11). Dep. CFSTI.

From 11th International Conference on Cosmic Rays, Budapest, Hungary.

The results of some experiments for a search for the neutrino radiation from the sun are described. Also discussed is the progress made toward increasing the sensitivity of the experiment. (J.F.P.)

26368 UPPER LIMITS FOR DIAGONAL AND NEUTRAL CURRENT COUPLINGS IN THE CERN NEUTRINO EXPERIMENTS. Cundy, D. C.; Myatt, G.; Nezrick, F. A.; Pattison, J. B. M.; Perkins, D. H.; Ramm, C. A.; Venus, W.; Wachsmuth, H. W. (CERN, Geneva). Phys. Lett.; 31B: 478-80(30 Mar 1970).

The 90% confidence limit for the coupling constant for $\nu_e + e^- \rightarrow e^- + \nu_e$ is found to be $G_{\text{diagonal}} < 18\ G_{\text{Fermi}}$. Upper limits for two possible neutral current processes are found to be: $(\nu_\mu + p \rightarrow \nu_\mu + p)/(\nu_\mu + n \rightarrow \mu^- + p) = 0.12 \pm 0.06$ and $(\nu_\mu + p \rightarrow \nu_\mu + \pi^+ + n)/(\nu_\mu + p \rightarrow \mu^- + \pi^+ + p) = 0.08 \pm 0.04$. (auth)

26369 LIMIT ON THE $K^+ \rightarrow \pi^+ + \nu + \bar{\nu}$ DECAY RATE. Klems, J. H. (Univ. of California, Berkeley. Univ. of Chicago); Hildebrand, R. H.; Stiening, R. Phys. Rev. Lett.; 24: 1086-90(11 May 1970).

The branching ratio for the process $K^+ \rightarrow \pi^+ + \nu + \bar{\nu}$ is shown by a counter spark chamber experiment to be less than 1.2×10^{-6} of all decay modes, assuming a pion energy spectrum like that of $K^+ \rightarrow \pi^0 + e^+ + \nu$. The apparatus was sensitive to pions in the kinetic energy range 117–127 MeV. (auth)

Strong (Baryon-Induced)

Refer also to abstract 26448.

26370 EVIDENCE FOR η^0 AND ω^0 MESON PRODUCTION IN THE REACTION $p + d \rightarrow {}^3He$ + MISSING MASS. Brody, H. (Univ. of Pennsylvania, Philadelphia); Groves, E.; Van Berg, R.; Wales, W.; Maglic, B.; Norem, J.; Oostens, J.; Cvijanovich, G. B.; Schluter, R. A. Phys. Rev. Lett.; 24: 948-51(27 Apr 1970).

Strong π^0, η^0, and ω^0 peaks were observed in the reaction $p + d \rightarrow {}^3He$ + missing mass at incident proton momenta of 3.5-3.8 GeV/c and proton-to-meson momentum transfer $t = -1.5\ (GeV/c)^2$. The mesons are produced with center-of-mass cross sections on the order of $10^{-34}\ cm^2/sr$ at a center-of-mass angle of about 60°. The missing-mass spectrometer combined the "Jacobian peak" and the orthogonal dispersion techniques. (auth)

26371 PION-EXCHANCE DOMINANCE IN THE REACTION $pp \rightarrow n\Delta^{++}(1236)$ AT HIGH ENERGIES. Ma, Z. Ming; Smith, G. A.; Sprafka, R. J.; Williamson, G. T. (Michigan State Univ., East Lansing). Phys. Rev. Lett.; 24: 1031-3(4 May 1970).

The charge-exchange reaction $pp \rightarrow n\Delta^{++}(1236)$ was systematically analyzed up to 24.2 GeV/c to test the concept of dominance in the t channel by high-lying Regge trajectories at very high energies. The results provide clear evidence for no more than pion exchange up to the highest momentum studied. (auth)

26372 THE EFFECTIVE MASS SPECTRUM OF LOW-ENERGY PROTON PAIRS IN PROTON–NUCLEUS INTERACTIONS AT 28.8 BeV/c. Azimov, S. A.; Beter, E. V.; Gulyamov, U. G.; Eroshkina, N. B.; Levin, A. Ya.; Rakhimbaev, B. G.; Reshitova, Z. A. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 4, 71-4(1969). (In Russian).

A special photoemulsion method, allowing to operate with "black" protons possessing a kinetic energy from 0.6 to 25 MeV, was used to determine resonances in the 2-proton system with an effective mass exceeding by about 10 MeV the twofold mass M of the proton (M = 938.3 MeV). The study involved a search for resonances in the 2-proton system by selecting stars with a large component of black rays in the nuclear emulsions included in the study. The histogram of the effective proton-pair mass spectrum was derived from the excess of real 2-proton combinations in a given star. This was obtained by a computer assisted study of 10 large stars. A statistically significant deviation from the background was obtained only at a low cutoff of the kinetic photon energy. A 2-proton resonance with a mass of about 1881 to 1883 MeV and a second one with an effective mass of about 1889 to 1891 MeV were considered possible. (TTT)

Strong (Meson-Induced)

Refer also to abstract 25298.

26373 THE REACTION $\pi^- p \rightarrow n\pi^0$ IN THE BACKWARD HEMISPHERE AT 6 GeV/c. Boright, J. P.; Bowen, D. R.; Groom, D. E.; Orear, J.; Owen, D. P.; Pawlicki, A. J.; White, D. H. (Cornell Univ., Ithaca, N. Y.). Phys. Rev. Lett.; 24: 964-7(27 Apr 1970).

The angular distribution for the charge-exchange reaction $\pi^- p \rightarrow n\pi^0$ was measured for an incident pion momentum of 6 GeV/c. The cross sections are presented for a range of crossed four-momentum transfer from $u = 0.06\ (GeV)^2$ (180°) to $u = -1.4\ (GeV)^2$ (66° lab). These data are compared with the predictions of Barger and Cline and are found to be in qualitative but not quantitative agreement. (auth)

26374 EVIDENCE AGAINST A_1 PRODUCTION IN HIGH-ENERGY K^+p INTERACTIONS. Rabin, Monroe S.; Barbaro-Galtieri, Angela; Derenzo, Stephen E.; Flatte, Stanley M.; Friedman, Jerome H.; Garnjost, Margaret A.; Solmitz, Frank T.; Uyeda, Norman M.; Windmolders, Roland (Univ. of California, Berkeley). Phys. Rev. Lett.; 24: 925-30(20 Apr 1970).

The production of the A_1 was reported at 12.8 GeV/c in the reaction $K^+p \rightarrow Kp(3\pi)$. It was also reported at 9.0 GeV/c in the reactions $K^+p \rightarrow Kp(3\pi)$ and $K^+p \rightarrow Kp(4\pi)$. At 12.0 GeV/c, with five times the data of the 12.8-GeV/c experiment and three times the data of the 9.0-GeV/c experiment, no evidence is seen for A_1 production in any of these reactions. (auth)

26375 EXPERIMENTAL STUDY OF THE REACTIONS $K^- + p \rightarrow \pi^- + \Sigma^+$ AND $K^- + p \rightarrow \pi^- + Y^{*+}(1385)$ AT 8 AND 16 GeV/c. Birnbaum, D. (Carnegie-Mellon Univ., Pittsburgh); Edelstein, R. M.; Hien, N. C.; (and others). Phys. Lett.; 31B: 484-8(30 Mar 1970).

Differential cross sections were measured for $K^- + p \rightarrow \pi^- + \Sigma^+$ and $K^- + p \rightarrow \pi^- + Y^{*+}(1385)$ at 8 and 16 GeV/c and at small momentum transfer, using the missing mass spectrometer technique. The cross sections continue to be a factor of two higher than those for the corresponding associated production reactions obtained by line reversal, in disagreement with exchange degeneracy. (auth)

26376 A STUDY OF THE REACTION $\pi^-p \rightarrow \pi^-\pi^+n$ AT 16 GeV/c. Ballam, J.; Chadwick, G. B.; Guiragossian, Z. G. T.; Johnson, W. B.; Leith, D. W. G. S.; Moriyasu, K. (Stanford Linear Accelerator Center, Calif.). Phys. Lett.; 31B: 489-92 (30 Mar 1970).

The analysis of the reaction $\pi^-p \rightarrow \pi^-\pi^+n$ at 16 GeV/c is presented. The total cross section for this channel was measured to be 0.40 ± 0.08 mb and production cross sections of 52 ± 13 μb and 38 ± 9 μb were determined for the ρ° and f° resonances, respectively. A comparison with the one-pion-exchange model of Wolf shows good agreement with the data. (auth)

26377 A NEW MEASUREMENT OF THE CROSS SECTION FOR "$\pi^-p \rightarrow$ ALL NEUTRALS" FROM 0.7 TO 1.6 GeV/c. Bizard, G. (Univ., Caen, France); Declais, Y.; Duchon, J.; Laville, J. L.; Seguinot, J.; Bricman, C.; Perreau, J. M.; Valladas, C. Phys. Lett.; 31B: 481-3(30 Mar 1970).

Measurements are reported on the cross section for the reaction π^-p yielding neutral final states in the momentum range 0.7 to 1.6 GeV/c. The π^-p total cross section was also obtained. (auth)

26378 THE $\pi^-p \rightarrow \eta n$ CROSS SECTION IN A SMALL TRANSFER RANGE AT 4 GeV/c. Hladky, J. (Joint Inst. for Nuclear Research, Dubna, USSR); Baldin, A. M.; Khachaturyan, M. N.; Khvastunov, M. S.; Shtarkov, L. N. Phys. Lett.; 31B: 475-7 (30 Mar 1970).

The reaction $\pi^- + p \rightarrow \eta + n$, $\eta \rightarrow 2\gamma$ was studied in a $0 \leq |t| \leq 0.24\ (\mathrm{GeV}/c)^2$ range at 4.0 GeV/c using spark chambers and Čerenkov total absorption gamma spectrometers. The coefficients $a = 4.3 \pm 0.8\ (\mathrm{GeV}/c)^{-2}$ and $b = 190 \pm 18\ \mu b/(\mathrm{GeV}/c)^2$ from the equation $d\sigma/dt = b \exp (at)$ were estimated. (auth)

26379 OBSERVATION OF A FOUR-PION RESONANCE AT 1630 MeV IN K^+p INTERACTIONS AT 10 GeV/c. Barnham, K. W. J. (Univ. of Birmingham, Eng.); Colley, D. C.; Jobes, M.; (and others). Phys. Rev. Lett.; 24: 1083-6(11 May 1970).

The observation of a new four-pion resonance $\rho(1630)$ with mass 1632 ± 23 MeV and width 110^{+18}_{-18} MeV produced in the channel $K^+p \rightarrow K^0\pi^+\pi^+\pi^-\pi^0p$ and decaying predominantly to $\rho^{0,-}\pi^{0,+}\pi^+$ and $\omega\pi^+$. No decay is observed into $\pi^+\pi^0$, $K^+\bar{K}^0$, $\rho^+\rho^0$, or $A_2\pi$, so that association with the g is precluded and the spin and parity probably lie in the unnatural series. The $\rho(1630)$ is associated with a $K\rho(1630)$ enhancement near threshold. This and other production characteristics are consistent with a double Regge pole exchange mechanism. (auth)

26380 PRODUCTION OF BARYON RESONANCES IN 6.7 GeV/c π^-p INTERACTIONS. Miyashita, S.; Von Krogh, J.; Kopelman, J. B.; Libby, L. Marshall (Univ. of Colorado, Boulder). Nuovo Chim.; 66A: 606-18(1 Apr 1970).

Except for Δ(1236), evidence for isobar production is observed in the $|I_z| = ½$ state at ~1500 MeV and ~1700 MeV mainly in $\pi\pi N$ mass distributions. They are enhanced if a πN mass combination is required in the Δ(1236). The decay characteristics favor $I = ½$ for both. The decay angular distributions favor $J \geq 3/2$ for both peaks. The peaks most likely correspond to $D_{13}(1520)$ and $F_{13}(1690)$ of the phase-shift analysis results. There is no evidence for any resonance production in the $\pi\pi\pi N$ mass distributions. (auth)

Particle Interactions and Properties (Theoretical)

General

Refer also to abstracts 25328 and 26475.

26381 A MONTE CARLO METHOD FOR GENERATING PERIPHERAL EVENTS. Byckling, E.; Kaartinen, M.; Kajantie, K.; Villanen, H. (Univ. of Helsinki). J. Comput. Phys.; 4: 521-30(Dec 1969).

An efficient Monte Carlo method for generating peripheral events is presented. The method is based on a form of the phase space integral which includes invariant momentum transfers among the variables. This makes it possible to generate events mainly in the region of the phase space where the matrix element is large. Using as a criterion the magnitude of the statistical error the increase of efficiency when compared with the conventional method is greater than (number of events generated in the whole phase space)/(number of events in the region where the matrix element is large). This is a large number, increasing with energy and multiplicity. (auth)

26382 REALIZATION OF CURRENT-ALGEBRA COMMUTATION RELATIONS ON THE SPACE OF SOLUTIONS OF FINITE- OR INFINITE-COMPONENT WAVE EQUATIONS. Barut, A. O.; Komen, G. J. (International Centre for Theoretical Physics, Trieste, Italy). Phys. Rev., D; 1: 418-22(15 Jan 1970).

The relation between the algebra of current densities and the finite- or infinite-component wave equations is critically investigated. It is found that, at any arbitrary momentum, the charge-current density commutation relations can be satisfied by the solutions of the wave equation, but only in a trivial sense, viz., if $J_0(0)$ is taken to be unity, in which case the content of the current commutators is essentially $1 \cdot J_\mu(k) = J_\mu(k)$, i.e., empty. Furthermore, it is shown explicitly in an example that, starting from the covariant wave equation, this condition $J_0(0) = 1$ can be satisfied only if it is made true by definition. The precise connection between the current algebra and infinite-component wave equations is discussed by the introduction of translation operators in momentum space. (auth)

26383 HIGH ENERGY PHYSICS INDEX. VOLUME 8, NO. 4, 16 FEB. 1970. Frankfurt am Main; Zentralstelle fuer Atomkernenergie Dokumentation (1970). 57p.

26384 HIGH ENERGY PHYSICS INDEX. VOLUME 8, NO. 5, 2 MARCH 1970. Frankfurt am Main; Zentralstelle fuer Atomkernenergie Dokumentation (1970). 59p.

26385 HIGH ENERGY PHYSICS INDEX. VOLUME 8, NO. 6, 16 MARCH 1970. Frankfurt am Main; Zentralstelle fuer Atomkernenergie Dokumentation (1970). 64p.

26386 HIGH ENERGY PHYSICS INDEX. VOLUME 8, NO. 7, 2 APRIL 1970. Frankfurt am Main; Zentralstelle fuer Atomkernenergie Dokumentation (1970). 72p.

26387 CANONICAL AND MANIFESTLY COVARIANT DESCRIPTIONS OF PARTICLES WITH ANY SPIN. Parravicini, G. (Univ., Milan. Istituto Nazionale di Fisica Nucleare, Milan); Sparzani, A. Nuovo Chim. 66A: 579-605(1 Apr 1970).

A large class of linear, first-order invariant equations, including all finite-dimensional equations, is explicitly shown to admit of a generalized PFWT transformation, which takes them into the canonical, or Foldy form. Accordingly, there are two forms of the restricted-Poincáre-group representations, which are connected by the same transformation. The effect of this transformation on the generators of the representation and on the position operator is extensively discussed. The converse transformation, from a Foldy-type equation to a manifestly covariant one, is by no means unique; in fact it is broadly arbitrary, in that there exists in all cases an infinite number of linear equations obtainable from a given canonical one. It is therefore possible, and in many ways, to have linear invariant equations describing arbitrary spin-mass spectra. (auth)

26388 LORENTZ-COVARIANT MATRICES FOR ELEMENTARY-PARTICLE THEORIES AS POLYNOMIALS IN THE SPIN MATRICES. Nelson, T. J. (Univ. of California, Berkeley); Good, R. H. Jr. J. Math. Phys. (N. Y.); 11: 1355-9(Apr 1970).

The problem of expressing the $(2s + 1) \times (2s + 1)$ covariantly defined matrices $S_{\mu\nu\rho}\ldots$ (used in theories of particles with spin) in terms of the angular-momentum matrices s is shown to be equivalent to the problem of finding a certain type of polynomial. Explicit expressions for the polynomials, recursion formulas, and differentiation properties are given. (auth)

26389 EQUIVALENCE BETWEEN TWO THEORIES OF ELEMENTARY OR COMPOSITE PARTICLES. Abou-Chacra, Ragi. Compt. Rend., Ser. A; 270: 625-8(2 Mar 1970). (In French).

The equivalence between two theories is studied. The particle is considered either elementary or composite. The equivalence cannot take place in the direction of the limit $g^2 \rightarrow \infty$ for a system in motion, even in the area $\eta = 2$. (France)

Electromagnetic

Refer also to abstracts 26365, 26366, 26416, 26478, and 26539.

26390 (AD-694033) DETERMINATION OF THE REAL PART OF THE COMPTON AMPLITUDE AT A NUCLEON RESONANCE. Brodsky, Stanley J.; Hearn, Anthony C.; Parsons, Ronald C. (Stanford Linear Accelerator Center, Calif. Stanford Univ., Calif. Inst. of Theoretical Physics. Texas Univ., Austin. Center for Particle Theory). Jul 1969. Contracts F44620-68-C-0075; SD-183. 24p. (CPT-10). CFSTI.

The real part of the virtual Compton amplitude can be directly determined from measurements of electron (or muon) bremsstrahlung or pair photoproduction. In general, the interference of the Compton amplitude with the Bethe–Heitler amplitude for pair production or bremsstrahlung yields a contribution to the cross section which is antisymmetric when the leptons are interchanged. This interference contribution thus produces different cross sections for electron and positron bremsstrahlung at a given scattering energy and angle. Also, the counting rate for pair production will depend on which lepton has the greater momentum. The determination of the real part of the Compton amplitude would supply information on the isobar resonance shape, test the dispersion relation for the forward amplitude, and resolve uncertainties in the determination of the nucleon resonances. A simple estimate for the lepton asymmetry of the pair production cross sections due to the forward Compton amplitude is given in addition to a complete calculation of the effect of the first nucleon resonance using the isobar model. The results are also discussed for nuclear targets. For the latter case, a broadening of the isobar decay width due to absorption in the nuclear medium must be taken into account. (auth) (USGRDR)

26391 (CALT-68-245) LOW t THEOREMS FOR CHARGED PION PHOTOPRODUCTION. Campbell, J. A.; Clark, Robert Beck (Texas Univ., Austin. Center for Particle Theory); Horn, D. (California Inst. of Tech., Pasadena). Mar 1970. Contract AT(11-1)-68. 27p. Dep. CFSTI.

Low t theorems for charged pion photoproduction are proved on the basis of gauge invariance restrictions. They can be simply formulated by means of the minimal gauge invariant extension of pion exchange (MPE). It is shown that whereas MPE leads in $\gamma N \rightarrow \pi^{\pm} N$ only to weak restrictions for $d\sigma/dt$ near the forward direction ($t \lesssim \mu^2$), it does actually account for all the structure observed in $\gamma p \rightarrow \pi^- \Delta^{++}$ in this t domain. Results for these reactions as well as the other charge modes of $\gamma N \rightarrow \pi^{\pm} \Delta$ are discussed and compared with experiment. (auth)

26392 (COO-427-98) OFF-MASS-SHELL VENEZIANO AMPLITUDES FOR $\gamma\pi \rightarrow \gamma\gamma$ AND $\eta \rightarrow \pi\pi\gamma$. Gupta, K. C. (Notre Dame Univ., Ind. Dept. of Physics). [1970]. Contract AT(11-1)-427. 10p. Dep. CFSTI.

γ-3π coupling constant and $\eta \rightarrow \pi\pi\gamma$ decay are studied under the assumptions of (i) current-field identity and (ii) an off-mass-shell extrapolation of Veneziano amplitudes for the respective strong processes. (auth)

26393 (DESY-70/8) RESONANT PRODUCTION OF VECTOR MESONS BY POLARIZED PHOTONS. SPECIAL CONSIDERATIONS ON THE ρN DECAY MODE OF $\Delta(1950)$ AND $\Delta(2420)$. Schildknecht, Dieter (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)); Schrempp, Barbara (Hamburg Univ. (West Germany). Institut fuer Theoretische Physik (II)). Feb 1970. 44p. Dep. CFSTI (U. S. Sales Only).

The differential cross section and the vector meson density matrix elements for resonant production of vector mesons from nucleons $\gamma N \rightarrow \text{Resonance}^J \rightarrow VN$ are given in terms of partial wave helicity and multipole amplitudes. A large J approximation of the $d^J(\theta)$ functions turns out to yield a good qualitative picture of the behavior of the differential cross section and density matrix elements for $J \gtrsim 11/2$. Numerical results for the differential cross section for $\gamma N \rightarrow \Delta^J \rightarrow \rho N$ and for the ρ density matrix elements are presented for the special model of magnetic excitation and decay, which is motivated from quark model and vector meson dominance model considerations. The observability of these resonance formation processes with unpolarized and polarized photons is extensively discussed by taking into account the diffractive background present in ρ^0 production from protons. Much of the material of this work may also be used to discuss resonance effects in Compton scattering. (auth)

26394 (DESY-70/13) PHOTOPRODUCTION OF e^+e^-, ρ–ω MIXING, AND VECTOR DOMINANCE. Quinn, H. R.; Walsh, T. F. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Mar 1970. 19p. Dep. CFSTI (U.S. Sales Only).

The ρ–ω mixing is discussed, in particular with respect to its possible effect on the invariant-mass spectrum of electron-positron pairs photoproduced off a nuclear target. It is found that the order of magnitude of the mixing indicated by recent experiments observing it in other processes would yield a significant effect on the e^+e^--photoproduction. The necessity for a consistent analysis of all channels in evaluating the mixing effect is emphasized. (auth)

26395 NEW DISPERSION SUM RULES FOR INELASTIC e–p SCATTERING. Leutwyler, H. (CERN, Geneva); Stern, J. Phys. Lett.; 31B: 458-60(30 Mar 1970).

Causality combined with scaling implies a set of sum rules for the electromagnetic structure functions. A local interpolation between the Regge and Bjorken limits is proposed to convert these relations into finite energy sum rules relating the deep inelastic and resonance regions. (auth)

26396 REMARKS ON π^+ PHOTOPRODUCTION WITH LINEARLY POLARIZED PHOTONS. Papaioannou, G. M.; Verganelakis, A. (Democritos Nuclear Research Center, Athens). Lett. Nuovo Cim.; 3: 559-62(25 Apr 1970).

In the discussion of the reaction $\gamma + n \rightarrow$ pseudoscalar meson + N for linearly polarized photons, it is shown that in the approximation, in which the contribution of the A_1 meson is negligible, it receives contributions only from natural-spin-parity exchanges for $0 < t < 0.6\ (\text{GeV}/c)^2$ and for the energies 2.6 to 16 GeV. Also it is shown that the approximations made for $(d\sigma/dt)_{11}$ are not valid. (J.F.P.)

26397 REBUTTAL OF THE PAPER "DIRAC ELECTRON IN ORTHOGONAL ELECTRIC AND MAGNETIC FIELDS" BY L. LAM. Canuto, V.; Chiuderi, C. (Goddard Space Flight Center, New York). Lett. Nuovo Cim.; 3: 551-2(25 Apr 1970).

A rebuttal is presented of previous work on the solutions of the Dirac equation in orthogonal electric and magnetic fields. (J.F.P.)

26398 PROPAGATION OF ELECTROMAGNETIC WAVES IN A DEGENERATE NEUTRINO SEA. Bandyopadhyay, Pratul (Indian Statistical Inst., Calcutta); Chaudhuri, Probhas Ray; Saha, Sushen Kumar. Phys. Rev., D; 1: 377-8(15 Jan 1970).

The propagation of electromagnetic waves in a Fermi sea of neutrinos is investigated on the basis of the photon-neutrino weak-coupling theory and is compared with the result obtained by Royer on the basis of the $(e\nu)(e\nu)$ coupling. It is shown that a photon propagating through the neutrino sea satisfies a dispersion relation of the form $\omega^2 = \omega_0^2 + k^2c^2$, where $(\hbar\omega_0)^2 \approx 6.2 \times 10^{-23}\ E_F{}^2$, E_F being the Fermi energy of the sea. Finally, some remarks are made as to the possibility of the destruction of a photon when propagating through the sea due to the process $\gamma + \nu \rightarrow \nu + \nu + \bar{\nu}$. It is found that the mean free path corresponding to this process is $\approx 10^{69}$ cm, much larger than the radius of the universe. (auth)

26399 HIGH-ENERGY PRODUCTION PROCESSES IN QUANTUM ELECTRODYNAMICS. Cheng, Hung (Massachusetts Inst. of Tech., Cambridge); Wu, Tai Tsun. Phys. Rev., D; 1: 456-8(15 Jan 1970).

Production amplitudes in quantum electrodynamics are studied in the high-energy limit. In particular, the impact factors for pair production and for bremsstrahlung are calculated explicitly. Numerous production amplitudes are then obtained in terms of these two impact factors. The method used is the one of impact diagrams, which is applicable to all Feynman diagrams at high energies. (auth)

26400 PARTICLES WITH INTEGRAL SPIN AND $B \neq 0$. Thornber, N. S. (Univ. of Bristol, Eng.). Phys. Rev., D; 1: 431-3(15 Jan 1970).

Constructing particles out of quarks (via infinite-component fields), it is shown that if an "elementary" particle has integral spin, baryon number $B \neq 0$, and a symmetric spin-isospin wave function, then its electromagnetic charge form factor vanishes. (auth)

26401 OBSERVABLE PARTICLE MOTIONS. Rafanelli, K. (Queens Coll., Flushing, N. Y.). Nuovo Cim.; 67A: 48-53(1 May 1970).

The method of Gordon is used to remove the zitterbewegung from the expectation values of the velocity and spin operators in the Dirac and Kemmer theories. To terms of first order in the electromagnetic-field gradients, these expectation values obey Good's classical Lorentz-covariant equations of motion, with coefficients characteristic of spin one-half and one respectively. (auth)

26402 AN OUTLINE OF A FIELD-THEORETIC METHOD FOR INCORPORATING FEEDBACK INTO CALCULATIONS OF THE NEUTRON–PROTON MASS DIFFERENCE. Heiko, L. (Instituto Politecnico Nacional, Mexico City). Lett. Nuovo Cim.; 3: 415-18(28 Mar 1970).

An alternative method to that used previously is considered for making the dependence on feedback explicit in calculations of the neutron–proton mass difference. The Cini–Ferrari–Gatto expression for the neutron–proton mass difference is generalized to αg^2(g is the rationalized $\pi + N$ strong-interaction coupling constant). The three-particle amplitude for $\gamma\pi N \rightarrow \gamma\pi N$ is discussed. (J.F.P.)

26403 SUM RULES AND BOUNDS FOR THE FORWARD COMPTON SCATTERING. Truong, T. N. (Ecole Polytechnic, Paris). Phys. Lett.; 31B: 461-4(30 Mar 1970).

Sum rules and bounds are given for the even crossing proton Compton amplitude under some weak assumptions. They can be used to test the validity of the dispersion relation. Lower bounds are obtained for the asymptotic behaviour of the proton and neutron amplitude. (auth)

26404 SPIN-DEPENDENT DEEP INELASTIC ELECTRON-PROTON SCATTERING. Galfi, L.; Kuti, J.; Patkos, A. (Roland Eoetvoes Univ., Budapest). Phys. Lett.; 31B: 465-9(30 Mar 1970).

The two spin-dependent structure functions in electroproduction cross sections are investigated asymptotically. It is suggested that the amplitude for spin-dependent virtual Compton scattering at large space-like photon masses is controlled by the dominant J-plane singularities and the constitution of the electric current. Experimental and theoretical implications of this conjecture are discussed. (auth)

26405 ANGULAR ASYMMETRY IN PAIR PRODUCTION BY POLARIZED BREMSSTRAHLUNG AT INTERMEDIATE ENERGIES. Kobayashi, Masaaki; Kondo, Kunitaka (Tokyo Univ.). J. Phys. Soc. Jap.; 28: 277-82(Feb 1970).

Method of measuring linear polarization of bremsstrahlung at intermediate energies is discussed. The polarization is determined from the angular distribution of electron positron pairs produced in an amorphous converter. The vertical distribution of electrons is detected by a wire spark chamber or a counter hodoscope and positrons by a large counter. The cross section is obtained analytically. The maximum asymmetry ratio of the cross section is 11 ~ 13% for photons with the energies higher than ~100 MeV. (auth)

26406 ELECTROMAGNETIC MASS DIFFERENCES OF THE PSEUDOSCALAR-MESON AND BARYON OCTETS. Nagylaki, Thomas (California Inst. of Tech., Pasadena). Contract AT(11-1)-68. Phys. Rev., D; 1: 637-48(15 Jan 1970).

An SU(3)-symmetric multichannel calculation of the electromagnetic mass differences in the pseudoscalar-meson and baryon octets is carried out with an attempt to include some of the physics of the crossed (pair-annihilation) channel along the lines of the recent work by Ball and Zachariasen. The importance of the tensor-meson Regge trajectories is emphasized. The agreement with experiment is poor for the isospin-1 mass differences, but excellent for those with isospin 2. (auth)

26407 ELECTRON-PHOTON SHOWER DISTRIBUTION FUNCTION. TABLES FOR LEAD, COPPER, AND AIR ABSORBERS. Messel, H.; Crawford, D. F. Oxford; Pergamon Press Ltd. (1970). 1515p. $67.00.

An extensive set of electron-photon shower distribution tables is presented. The tables contain data relating to the propagation of high energy electrons and photons through matter. The 2946 separate tables were obtained through extensive Monte Carlo calculations, covering electron and photon primaries of energies from 100 MeV to 10,000 MeV and secondary energies beginning at 1 MeV. Showers are considered in lead, copper, and air absorbers. Four introductory and explanatory chapters precede the tables. These deal with the method of simulating the electron-photon cascade on a digital computer, cross sections for all processes simulated in the KDF9 program and the manner in which each process is simulated, and results obtained from the SILLIAC and KDF9 programs. (L.B.S.)

26408 FOURTH-ORDER RADIATIVE CORRECTIONS TO THE ELECTRON-PHOTON VERTEX. Barbieri, R. (Scuola Normale Superiore, Pisa, Italy); Mignaco, J. A.; Remiddi, E. Lett. Nuovo Cim.; 3: 588-91(2 May 1970).

The results are reported of an evaluation of contributions from corner graphs and electron self-mass graphs to the slope of the Dirac form factor of the electron at zero-momentum transfer. (L.B.S.)

26409 ELECTROMAGNETIC MASS DIFFERENCES AND THE YENNIE GAUGE. Dothan, Y.; Grossman, Z. (Tel Aviv Univ., Israel). Lett. Nuovo Cim.; 3: 604-7(2 May 1970).

It is shown that the Yennie gauge is a convenient gauge to use when evaluating electromagnetic mass differences in the location of the single-particle singularity. The case of the $\pi^+ - \pi^0$ mass difference is considered. (L.B.S.)

Weak

Refer also to abstract 26398.

26410 (NYO-3829-47) HIGHER ORDER TERMS IN THE CURRENT-CURRENT THEORY OF WEAK INTERACTIONS. Willey, R. S.; Tarter, J. M. (Pittsburgh Univ., Pa. Dept. of Physics). Feb 1970. Contract AT(30-1)-3829. 43p. Dep. CFSTI.

A study is made of the consequences of the hypothesis that, for some range of energies, the second order terms in the perturbation expansion of the Fermi theory are small but nonnegligible corrections to the first order terms, and responsible for reactions which violate first order selection rules. Matrix elements are computed through second order in the weak coupling constant G and subtraction constants which are necessary to render the matrix elements finite to this order are introduced. From this point of view a number of weak interaction problems are considered including the experimental parameters of μ-decay, the universality of the μ-decay coupling constant and the Fermi β-decay coupling constant, K_{l3} decays, and $\Delta S = \Delta Q$ and $\Delta S = 2$ semileptonic decays. (auth)

26411 SOME REMARKS ON THE SCALAR FORM FACTOR IN K_{l3} DECAY. Haidt, D.; Rein, D.; Rodenberg, R.; Zerwas, P. (Technische Hochschule, Aachen). Nuovo Cim.; 67A: 113-24 (1 May 1970).

Including Z-diagrams in the Fubini-Furlan sum rule one obtains an increasing scalar form factor in the K_{l3} decay. Consequences of a small symmetry-breaking parameter c in the strong-Hamiltonian density are discussed. (auth)

26412 FIELD-CURRENT IDENTITY, CHIRAL DYNAMICS, AND THE K_{l3} FORM FACTORS. Majumdar, D. P. (Univ. of Colorado, Boulder. Syracuse Univ., N. Y.). Phys. Rev., D; 1: 684-96(15 Jan 1970).

The K_{l3}-decay form factors $f_{\pm}(t)$ are discussed from a phenomenological Lagrangian approach based on the notions of chiral dynamics and field-current identity. For the spin-zero fields, a real σ model in $SU(3) \otimes SU(3)$ is considered. The vector and axial-vector fields are introduced as gauge fields in this model, which then preserves the concept of field-current identity. The model has been made general so that one can study the possibility of both the kinetic-energy-mixing and the mass-mixing models for the massive gauge fields. It is found that the strong vector-meson decays $\rho \rightarrow \pi\pi$ and $K^* \rightarrow K\pi$ and the weak K_{l3} decays form a consistent picture in this model. For comparison with experiments, expressions of experimentally measurable quantities are first derived for the general case of simultaneous mass and kinetic-energy mixing. The results for each of these kinds of gauge-field model are then studied separately. It is found that the Glashow-Weinberg relation for $f_+(0)$ should be exact up to second order in symmetry breaking for a gauge-field model where the symmetry breaking is manifested only through changes in the kinetic-energy matrix Z and the mass matrix M. Expressions for the corrections to the K_{l3} form factors due to the existence of the scalar mesons are derived. In the limit of the nonexistent κ meson (i.e., $m_s \rightarrow \infty$ and $f_s \rightarrow 0$), all the results reduce to those of Lee. Some discrepancies between the present work and the work of other authors using the current-algebra techniques are discussed. (auth)

26413 ORIGIN OF THE WEAK-INTERACTION ANGLE. II. Cabibbo, N. (Univ., Rome. Istituto Nazionale di Fisica Nucleare, Rome); Maiani, L. Phys. Rev., D; 1: 707-18(15 Jan 1970).

A theory of the origin of the weak-interaction angle θ is presented, based on a self-consistency condition linking weak, strong, and electromagnetic symmetry-breaking effects. The value of θ is related to the observed pattern of breaking of $SU(3) \otimes SU(3)$, and depends upon the value of a new parameter ξ, which gives the strength of the weak corrections to strong processes. A characteristic result of the theory is the prediction of a nonelectromagnetic isospin breaking. This solves the $\eta \rightarrow 3\pi$ puzzle and accounts for the observed deviation from the Dashen sum rule: $m_{K^{+2}} - m_{K^{02}} = m_{\pi^{+2}} - m_{\pi^{02}}$. Although a theoretical evaluation of ξ could not be given in a realistic model of weak interactions, a phenomenological determination of ξ is proposed, based on the observed isospin-breaking mass splittings among pseudoscalar mesons. In this the prediction $\theta \approx 0.25$ is obtained, which is in good agreement with the experimental value. (auth)

26414 LONG-RANGE WEAK FORCES AND COSMOLOGY. Hartle, James B. (Univ. of California, Santa Barbara). Phys. Rev., D; 1: 394-7(15 Jan 1970).

Long-range weak-interaction forces arising from multiple neutrino exchange do not significantly affect the evolution of a homogeneous, isotropic universe. Inhomogeneities can induce an effective local $1/r^2$ force between electrons but the magnitude of this force is much smaller than gravity for our universe. (auth)

26415 VENEZIANO-TYPE K_{l3} FORM FACTORS. Hussain, F.; Razmi, M. S. K. (Univ. of Islamabad, Rawalpindi, Pakistan). Lett. Nuovo Cim.; 3: 339-43(14 Mar 1970).

A calculation of the form factors for $K \rightarrow \pi + l + \nu$ decay is made without extrapolation in the kaon case. It is found that the representation for the form factors is somewhat different from the one with soft kaons in that the arguments of the gamma functions are slightly different, the D-wave coupling constant in the $K_A K_\pi^*$ system need not be zero, and the Callan–Trieman relation is satisfied, also the prediction for $F_K/F_\pi F_+ (0)$ agrees with the experimental result. (J.F.P.)

Strong (General)

26416 (DESY-70/12) SCATTERING THEORY FOR STRONG AND ELECTROMAGNETIC INTERACTIONS OF RELATIVISTIC TWO-PARTICLE SYSTEMS. Schierholz, G. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany). Hamburg Univ. (West Germany). Institut fuer Theoretische Physik (II)). Mar 1970. 18p. Dep. CFSTI (U. S. Sales Only).

Relativistic two-particle scattering is generalized to include electromagnetic interactions. A Hamiltonian consistent with the commutation relations of the inhomogeneous Lorentz group and the principle of minimal electromagnetic coupling is derived and can be defined selfadjoint. The scattering operator is computed and found to admit a representation suitable for calculations due to the invariance property of the Møller operators. Finally, the photodisintegration of bound states is discussed briefly. (auth)

26417 (SLAC-Trans-112) FORMATION OF SHOWERS IN RESCATTERINGS AND THE GROWTH OF THE TOTAL CROSS-SECTIONS AS $E \rightarrow \infty$. Lendel, A. I.; Ter-Martirosyan, K. A. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). Translated for Stanford Linear Accelerator Center, Calif., from report ITF-69-89. 9p. Dep. CFSTI.

This item was previously abstracted from the original language and appeared in NSA as 24: 20076. (J.F.P.)

26418 FACTORIZATION OF MULTIPION PRODUCTION. Lo, S. Y. (Glasgow Univ.). Lett. Nuovo Cim.; 3: 555-8(25 Apr 1970).

The factorizable form of an equation for multiple pion production in hadron strong interactions is given and discussed. The Poisson for the multiplicity is also discussed. It is found that the average multiplicity decreases exponentially, and it is uncertain which reference frame should be used for this equation. The total inelastic cross section of all multipion processes can be expressed in terms of any two cross sections. Some flaws in these equations are also pointed out. (J.F.P.)

26419 HIGH-ENERGY BEHAVIOR OF CHIRAL LAGRANGIANS AND THE PROCESS $\pi_a + \alpha \rightarrow \pi_b + \pi_c + \beta$. McDonald, A. (Purdue Univ., Lafayette, Ind.). Phys. Rev., D; 1: 721-2(15 Jan 1970).

Weinberg's approach to the high-energy behavior of chiral Lagrangians is applied to the process $\pi + \alpha \rightarrow 2\pi + \beta$, and it is shown that the algebraic relations required to give good asymptotic behavior in this process are the same as those which give good behavior in the reaction $\pi + \alpha \rightarrow \pi + \beta$. (auth)

26420 SPACE–TIME DESCRIPTION OF HADRONS. II. Domokos, G.; Kovesi-Domokos, S.; Mansouri, F. (Johns Hopkins Univ., Baltimore). Contract AT(30-1)-4076. Phys. Rev., D; 1: 512-22(15 Jan 1970).

Interactions of composite (Reggeized) hadrons are investigated. A scheme is given for writing down trilinear vertices between hadrons that is consistent with Lorentz invariance. The vertices become local when the hadrons involved are put on their mass shells (physical points of the trajectories). A graphical method, similar to Feynman diagrams, is developed for writing down scattering amplitudes involving composite hadrons. The procedure for constructing scattering amplitudes is stated in terms of a few rules. The example of elastic scattering of spinless particles with the exchange of a single Lorentz pole is briefly discussed; it is shown that the diagram rules lead to the well-known expression for a scattering amplitude with rapidly decreasing residues. (auth)

26421 SPACE-TIME DESCRIPTIONS OF HADRONS. I. Domokos, G.; Kovesi-Domokos, S.; Mansouri, F. (Johns Hopkins Univ., Baltimore). Contract AT(30-1)-4076. Phys. Rev., D; 1: 500-11(15 Jan 1970).

The possibility of describing the interactions of composite ("Reggeized") hadrons in space-time is investigated. A formalism giving a unified description of the spin states of composite hadrons is constructed. A Lorentz family of hadron Regge trajectories allows the introduction of local hadron amplitudes. Investigation of the covariance properties of the local hadron amplitudes with respect to proper complex Lorentz transformations, space and time inversion, charge conjugation, and gauge transformations establishes the principles according to which observed families of hadron states are described in terms of representations of the complex Lorentz group. It is found that covariance under these transformations necessarily demands parity doubling ("MacDowell symmetry") for meson as well as fermion trajectories. In a world of parallel Regge trajectories (unbroken Lorentz symmetry), chirality is exactly conserved. A manifestly Lorentz-covariant description of the propagation of composite hadrons is given. Explicit expressions for the composite hadron propagators are given for chiral singlet mesons and chiral doublet fermions. Examples of physical assignments are briefly discussed. It is found in particular that particles of unit baryon number transform according to representations of the complex Lorentz group with Toller quantum number $M = \frac{1}{2}$. (auth)

26422 DIFFRACTION SCATTERING FOR INELASTIC PROCESSES. Cheng, Hung (Massachusetts Inst. of Tech., Cambridge); Wu, Tai Tsun. Phys. Rev., D; 1: 459-66(15 Jan 1970).

Previous treatments on high-energy scattering in quantum electrodynamics are extended to diffractive inelastic processes. The model in which the diffractive excitation proceeds through the exchange of vector mesons is explored. Six inelastic impact factors are explicitly calculated in the lowest order: (1) scalar to scalar, (2) pseudoscalar to pseudoscalar, (3) vector to vector, (4) axial vector to axial vector, (5) scalar to axial vector, and (6) pseudoscalar to axial vector. For all six of these impact factors, the masses of the incoming and outgoing particles may be different; and for the last two impact factors, the spins and the parities of the incoming and outgoing particles may be different. The nonvanishing of the impact factors demonstrates that mass, spin, and parity can change during a diffractive process. It is also concluded that C (charge conjugation quantum number), S (strangeness), I (isotopic spin), B (baryon number), and G parity, etc., must remain the same during a diffractive process. Some general properties of the impact factor are also discussed. (auth)

26423 REGGE POLES AND PARTICLE PHYSICS. Tassic, L. J. (Australian National Univ., Canberra). Aust. Phys.; 6: 149-54(Oct 1969).

Regge pole applications to high energy physics are discussed, following an introduction on particle terminology. Regge trajectories for strongly interacting particles are predicted, and the evidence for these trajectories is discussed. (auth)

Strong (Baryon No. = 0)

Refer also to abstract 26449.

26424 A UNITARIZED VENEZIANO MODEL FOR PION–PION SCATTERING. Kang, K. (Brown Univ., Providence). Lett. Nuovo Cim.; 3: 576-80(25 Apr 1970). (NYO-2262TA-201).

A unitarization method for the Veneziano model is proposed which respects crossing symmetry in the low-energy region and gives equally good results without numerical integrations as those previously obtained with these integrations. (J.F.P.)

26425 GENERATING FUNCTIONALS, WARD IDENTITIES, AND SCALAR MESONS. Parisi, G.; Testa, M. (Univ., Rome). Nuovo Cim.; 67A: 13-22(1 May 1970).

A general and concise treatment of Ward identities in current algebra with broken symmetry is presented. An application is also presented to the mass spectrum and leptonic decay constants of the scalar and pseudoscalar mesons. (auth)

26426 ELASTIC SCATTERING PROCESSES IN SCALAR ELECTRODYNAMICS AT HIGH ENERGIES. I. Cheng, Hung (Massachusetts Inst. of Tech., Cambridge); Wu, Tai Tsun. Phys. Rev., D; 1: 467-73(15 Jan 1970).

A study is made of all elastic scattering amplitudes in scalar electrodynamics at high energies. The impact factors for the scalar meson and for the vector meson in this theory are explicitly calculated in the lowest order. It is also shown that the elastic amplitudes still satisfy an impact-factor representation after all vector-meson exchanges are summed, and an exponentiation, similar to that in quantum electrodynamics, is obtained. (auth)

26427 THREE-MESON PROBLEM IN DISPERSION THEORY. Scarfone, Leonard M. (Univ. of Vermont, Burlington). Phys. Rev., D; 1: 584-95(15 Jan 1970).

The addition of a meson to the 2V sector of the Lee model provides an opportunity to study collision problems involving two composite particles formed by the exchange of one and two such mesons. Following Amado, a dispersion treatment is given which avoids five-particle intermediate states, but previously excluded four-particle states now make their appearance. It is found, as in the recent three-meson example of Bronzan, that the dynamics reduces to the solution of a Fredholm integral equation in one variable brought about by a factorization property of the connected S matrix in the 2V sector. Similarities and differences between the two cases are pointed out. Dispersion-theoretic investigations of the one- and two-meson exchange interactions of two nucleons in crossing-symmetric static models, and the scattering of a meson by these nucleons are indicated for future consideration. (auth)

26428 ρ BOOTSTRAP USING THE VENEZIANO REPRESENTATION. Antippa, Adel F.; Everett, Allen E. (Tufts Univ., Medford, Mass.). Phys. Rev., D; 1: 606-23(15 Jan 1970).

A ρ bootstrap calculation, using the Baláźs method, with the input crossed-channel amplitude given by the Veneziano representation, was performed. Results for the self-consistent mass and width are in good agreement with experiment. The results are consistent with the amplitude being given by only a single Veneziano term, although they do not exclude the presence of additional terms with lower-order asymptotic behavior. (auth)

26429 π-ρ SCATTERING IN THE VENEZIANO MODEL. Abers, Ernest S.; Teplitz, Vigdor L. (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-2098. Phys. Rev., D; 1: 624-36(15 Jan 1970).

The conditions for nondegeneracy of the leading trajectory in scalar-vector scattering are derived. They are applied to the Veneziano model for the pion contribution to the π-ρ scattering amplitude. A general class of models for the double-charge-exchange process is found, and a "minimal" model is discussed in detail. The Adler self-consistency condition and its relation to the quantization rules of Ademollo et al. is discussed. The possible existence of exotic resonances or an I = 0 trajectory degenerate with the π trajectory is also discussed. (auth)

26430 THE VENEZIANO MODEL AND CHIRAL ALGEBRA IN πA_1 SCATTERING. Whippman, M. L. (Univ. of Pennsylvania, Philadelphia). Phys. Rev., D; 1: 701-6(15 Jan 1970).

A model of the Veneziano type is constructed for πA_1 elastic scattering. It is found that the imposition of factorization determines the model almost completely in terms of models for $\pi\pi \rightarrow \pi\pi$ and $\pi\pi \rightarrow \pi A_1$; and that the mere existence of a model for $\pi A_1 \rightarrow \pi A_1$ constrains the model for $\pi\pi \rightarrow \pi A_1$. An off-shell continuation of the model consistent with the hard-pion formalism is given. The combination of this continuation with the constraint mentioned above ensures that the "constants" multiplying the Veneziano functions must depend explicitly on the four-momentum squared of the particle off the mass shell; and that the Adler consistency condition is satisfied by the vanishing of these constants at zero four-momentum rather than by a condition on the trajectory function or the external masses. (auth)

26431 VECTOR-MESON DOMINANCE AND THE $A_1\rho\pi$ SYSTEM. Konetschny, W. (Technische Hochschule, Vienna). Lett. Nuovo Cim.; 3: 419-22(28 Mar 1970).

The correlation between the coupling constants occurring in the $A_1\pi\gamma$ and $A_1\rho\pi$ matrix elements is investigated starting with a field–current identity. Form factors are defined and coupling constants are introduced. It is found that this procedure gives an unambiguous result for the coupling constants. This result is discussed in the light of the assumption required. (J.F.P.)

26432 EFFECT OF ANNIHILATION ON MATTER–ANTIMATTER SEPARATION. Omnes, R. (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Phys. Rev., D; 1: 723-4(15 Jan 1970).

The effect of the annihilation of nucleon-antinucleon pairs upon the process of matter-antimatter separation in blackbody radiation is considered. It is shown to be negligible if annihilation is correctly described by the statistical model. (auth)

26433 MESON WAVE FUNCTION RENORMALIZATION CONSTANTS AND ASYMPTOTIC SYMMETRY. Aly, H. H.; Narayanaswamy, P. (Southern Illinois Univ., Edwardsville). Lett. Nuovo Cim.; 3: 357-62(14 Mar 1970).

Previously a simple relation connecting the wave function renormalization constants of the mesons (π) and (K) with their masses and decay constants was derived. The derivation was based on the hypothesis of a strong asymptotic symmetry. It is shown that a weaker set of assumptions also leads to a simple relation for the masses of these mesons and the masses of the ρ and K. This indicates a previous conjecture that the renormalization constants of field theory are related to the particle masses. (J.F.P.)

26434 DUAL MODELS, POMERANCHUK TERM, AND CROSSING SYMMETRY. Del Giudice, E.; Veneziano, G. (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-2098. Lett. Nuovo Cim.; 3: 363-8(14 Mar 1970).

Some of the properties that a Pomeranchuk term should possess in order to maintain crossing symmetry and good high-energy behavior in all channels are examined. Restriction is made to the case of $\pi + \pi$ interactions. (J.F.P.)

26435 UNITARIZED AND NEARLY CROSSING-SYMMETRIC π-π S-WAVE AMPLITUDES. Baier, R. (Univ., Graz); Kuehnelt, H.; Widder, F. Lett. Nuovo Cim.; 3: 594-7(2 May 1970).

An attempt to unitarize the Veneziano model for the $\pi\pi$ system using a generalized K-matrix formalism has resulted in the violation of crossing symmetry at low energies. An attempt is made to minimize this violation for the isospin I = 0 and I = 2 S-waves by taking into account restrictions imposed by the general properties of the $\pi\pi$ partial-wave amplitudes expressed by certain inequalities. (L.B.S.)

26436 PHYSICAL-REGION DISCONTINUITY EQUATIONS FOR MANY-PARTICLE SCATTERING AMPLITUDES. II. Coster, Joseph; Stapp, Henry P. (Univ. of California, Berkeley). J. Math. Phys. (N. Y.); 11: 1441-63(Apr 1970).

Discontinuity equations are derived for physical-region normal thresholds in all direct and crossed channels. The discontinuity is given as a unitarity-type integral with an integrand that contains, as factors, the two physical scattering functions corresponding to the two vertices of the Landau diagram associated with the normal threshold. There is also a third factor, which for the case of a leading normal threshold with any number of particles is the Hermitian conjugate of the elastic scattering matrix associated with the set of internal lines of the Landau diagram. For nonleading normal thresholds below the lowest 4-particle threshold, the extra factor is defined by an integral equation that resembles unitarity, but has a restricted set of intermediate particles. (auth)

Strong (Baryon No. = 1)

26437 (UR-875-304) COMMENTS CONCERNING THE EFFECTS OF K-π MISIDENTIFICATION UPON THE DETERMINATION OF THE DECAY PROPERTIES OF THE Q. Ferbel, T.; Holmes, R.; Slattery, P.; Werner, B. (Rochester Univ., N. Y.). Apr 1970. Contract AT(30-1)-875. 11p. Dep. CFSTI.

An attempt is made to investigate some of the possible effects of K–π ambiguities upon studies of the decay characteristics of the Q in $K^\pm + p \rightarrow Q^\pm + p$, $Q^\pm \rightarrow K^\pm + \pi^+ + \pi^-$ interactions. A total of 208 K–π ambiguous events are examined in order to ascertain the extent of possible biases in a sample of Q^+ data, and scatter plots are presented comparing the two acceptable kinematic hypotheses. (J.F.P.)

26438 LORENTZ-POLE ANALYSIS OF THE REACTION $\pi^+p \rightarrow \pi^0\Delta^{++}(1236)$. Samiullah, M.; Rao, A. Srinivas (Osmania Univ., Hyderabad, India). Nuovo Cim.; 66A: 657-62(21 Apr 1970).

The high-energy behavior of the reaction $\pi^+p \rightarrow \pi^0\Delta^{++}(1236)$ is analyzed within the context of the $O_{3,1}$ symmetry formalism. It is found that the dominant amplitudes to the differential cross section are $\langle 0\tfrac{1}{2}|T|0\tfrac{1}{2}\rangle$ and $\langle 0\tfrac{3}{2}|T|0\tfrac{1}{2}\rangle$. A ρ' exchange in addition to the ρ exchange is allowed in this analysis which is useful to explain the polarization properties of the Δ^{++} isobar. (auth)

26439 FIELD-THEORETIC MODEL FOR HIGH-ENERGY SCATTERING. II. REGGE AND NON-REGGE DAMPING IN πN SCATTERING. Fried, H. M. (Brown Univ., Providence). Phys. Rev., D; 1: 596-605(15 Jan 1970). (NYO-2262TA-207).

A field-theoretic formulation of πN scattering, combining soft virtual neutral vector-meson exchange with simple nucleon, 3-3 resonance, and ρ poles, is shown to produce damped amplitudes containing both fixed and Regge poles, yielding polarizations and differential cross sections with a qualitative resemblance to recent experiments. (auth)

26440 BARYON SPECTRAL-FUNCTION SUM RULES. Genz, H. (Univ. of California, Berkeley). Phys. Rev., D; 1: 659-62(15 Jan 1970).

Necessary and sufficient conditions for baryon spectral-function sum rules are obtained under the assumptions that (1) the equal-time commutator of the axial charges $Q_5^a(x_0)$ (a = 1,2,3) and the nucleon field $\bar{\psi}(y)$ is given by $[Q_5^a(y_0), \bar{\psi}(y)] = -r_A\bar{\psi}(y)\gamma_5\tau^a +$ ($\Delta I = \tfrac{3}{2}$ terms) and that (2) the axial-vector current $A_\mu^a(x)$ is conserved. For each of these sum rules (enumerated by n = 1,2,3 . . .), the equivalence to $\int d^3z \langle [Q_5^a(y_0), [(\partial/\partial y_0)^{2n-1}\bar{\psi}(y), \bar{\psi}(z)]_+]|_{y_0=z_0}\rangle_0 = 0$ is actually shown under weaker conditions: assumption (1) and, instead of (2), $\Sigma_{j=0}^{2n-2}\langle[\{(\partial/\partial y_0)^j[\int d^3x\, \partial^\mu A^a_\mu(y_0x), (\partial/\partial y_0)^{2n-2-j}\psi(y)]\}, \psi(z)]_+|_{y_0=z_0}\rangle_0 = 0$. Further equivalences are given. The sum rules connect the ($I = 1/2$, $J = 1/2$, $J = 1/2^+$) and ($I = 1/2$, $J = 1/2^-$) baryon spectrum and include (for $n = 1$) a sum rule, obtained independently by Rothleitner and (in the one-particle approximation) by Sugawara. In our derivation no assumptions are made on high-energy behavior and an identity of the Jacobi type is used. Assuming the first two sum rules to be valid, the model then predicts a P_{11}(m > 1470 MeV) resonance [which may be identified as the observed P_{11}(1750)] from the existence of the four nucleon resonances P_{11}(940), P_{11}(1470), S_{11}(1550), and S_{11}(1710). (auth)

26441 THE POMERANCHUK THEOREM AND THE POMERANCHUK–OKUN RULE. Kottler, H. (Univ. of Pittsburgh). Contract AT(30-1)-3829. Nuovo Cim.; 67A: 88-95(1 May 1970).

It is pointed out that the so-called Pomeranchuk-Okun rule for the asymptotic vanishing of the charge-exchange amplitudes follows directly in many of the more interesting cases from asymptotic isospin invariance and the Pomeranchuk theorem. It is also shown that this combination of asymptotic internal invariance and the Pomeranchuk theorem yields many asymptotic cross section relations which are otherwise unobtainable. (auth)

26442 REGGE POLE RESIDUES NEAR $\alpha = 0$ IN THE PRESENCE OF FIXED POLE EFFECTS. Chiu, C. B.; Matsuda, S. (California Inst. of Tech., Pasadena). Contract AT(11-1)-68. Phys. Lett.; 31B: 455-7(30 Mar 1970).

A certain channel independent feature of fixed pole effects in Regge pole residues for hadronic processes is discussed, and the residues of the ω and the ρ in the presence of these effects is investigated. The analysis suggests that a dip is expected for all reactions associated with the dominance of the ω exchange. (auth)

26443 FINAL-STATE INTERACTIONS FOR 3 PARTICLES. Smadja, G. (CEN, Saclay, France). Nuovo Cim.; 67A: 96-112(1 May 1970).

An angular-momentum analysis of reactions with three final particles of any spin is first performed. It is then shown how the isobar model, with well-defined kinematical factors, arises from the analytical properties of the amplitude. From a K-matrix formalism, a model is then derived which takes account of both initial- and final-state interactions. A numerical check of this model is tried on the decay $P_{11} \to \Delta\pi$. (auth)

Strong (Baryon No. ≥ 2)

26444 (INR-1151) HYPERNUCLEI Λ-N INTERACTION AND HYPERNUCLEAR SPECTROSCOPY. Pniewski, Jerzy (Institute of Nuclear Research, Warsaw (Poland)). 1969. 67p. Dep. CFSTI (U. S. Sales Only).

A review is given of the problems of Λ-N interactions and hypernuclear spectroscopy. The main experimental results related to these problems are briefly summarized. Topics covered include: experimental data on Λ-binding energies and hypernuclear spins, field theoretic approach to the Λ-N strong interaction, phenomenological theory of hypernuclei, Λ-p elastic scattering, charge symmetry breaking effects in the Λ-N interactions, hypernuclear resonances, hypernuclei isomers, short-lived γ-transitions, and perspectives of the counter technique for hypernuclear spectroscopy. In summary it is concluded that two main problems waiting to be solved by hypernuclear spectroscopy are the real spin-dependence and the contribution of the possible noncentral components of the Λ-N interaction. (70 references) (L.B.S.)

26445 (ITF-69-91) THE HILBERT–SCHMIDT EXPANSION AND SOLUTION OF THE FADDEEV EQUATIONS WITH THE SQUARE-WELL POTENTIAL. Kharchenko, V. F.; Storozhenko, S. A. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1969. 18p. (In Russian). Dep. CFSTI (U. S. Sales Only).

The motion of three identical spinless particles and the three-nucleon problem are considered in the case of pair interaction between particles characterized by the local square-well potential. The application of the separable Hilbert–Schmidt expansion allows one to reduce the problem to solving the set of single-variable integral equations. The three-particle binding energy and the scattering length of three identical spinless particles are calculated as well as the triton binding energy and the neutron-deuteron scattering lengths. The evaluation is made of the value of contribution into the binding energies and the scattering lengths of three-particle systems from the components of two-particle interaction in the states with the values of the orbital moment different from zero. (auth)

26446 (JINR-E2-4955) EIKONAL APPROXIMATION FOR THE INELASTIC SCATTERING AMPLITUDE IN QUANTUM FIELD THEORY MODEL. Barbashov, B. M.; Kuleshov, S. P.; Pervushin, V. N.; Sissakian, A. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1970. 12p. Dep. CFSTI (U. S. Sales Only).

Processes of scattering of two scalar nucleons with production of scalar mesons in the model $L_{int} = g\colon \psi^2(x)\phi(x)\colon$ are considered. The case of single particle production is investigated in detail. It is shown that it is possible to represent the inelastic scattering amplitude in terms of the eikonal elastic amplitude in a certain region of the momenta of the produced particle. (auth)

26447 (JINR-P2-4937) NUCLEON POLARIZATION IN THE REACTIONS $NN \to NN\pi$ AT 669 MeV IN THE ONE-PION-EXCHANGE MODEL. Azhgirei, L. S.; Chizhikov, V. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1970. 27p. (In Russian). Dep. CFSTI (U.S. Sales Only).

The calculations of the proton polarization in the reactions $pp \to pn\pi^+$ and $pp \to pp\pi^0$ at 669 MeV are performed within the framework of the one-pion-exchange model. It is shown that polarization is due, in general, to the interference of the resonance P_{33}-amplitude with the nonresonant amplitudes of the virtual π-N scattering. The value and the angular dependence of the polarization are very sensitive to the behavior of the π-N scattering amplitudes off the mass shell and to the assumptions about the nucleon form-factor. Experimental investigation of the secondary proton polarization in the reactions $pp \to NN\pi$ and the analysis of the data within the scope of the one-pion-exchange model can yield the information on the mechanism of a single pion production at 669 MeV. (auth)

26448 SPECULATION ON THE HELICITY OF A VIRTUAL (TIMELIKE) PHOTON EMITTED IN HADRON–HADRON COLLISIONS. Sakurai, J. J. (Univ. of California, Los Angeles). Phys. Rev. Lett.; 24: 968-9(27 Apr 1970).

It is conjectured that the linear polarization of a large-mass timelike photon emitted in high-energy hadron-hadron collisions is predominantly longitudinal ($\lambda = 0$). The conjecture can be tested experimentally by studying the decay angular distribution of muon pairs produced in $p\ (\pi) + N \to \mu^+ + \mu^-$ + hadronic system. (auth)

26449 POLARIZATION IN p-p AND $\bar{p}$-p ELASTIC SCATTERING. Sohlo, S. (Univ. of Oulu, Finland); Byckling, E. Lett. Nuovo Cim.; 3: 608-13(2 May 1970).

A simple model consisting of a dual, exchange-degenerate Veneziano part and a term describing the Pomeron is presented for describing pp and $\bar{p}$p high-energy elastic scattering near the forward direction. (L.B.S.)

Particle Invariance Principles and Symmetries

General

26450 (ITF-70-4) REPRESENTATIONS OF THE TOTAL INHOMOGENEOUS DE SITTER GROUP AND EQUATIONS IN A FIVE-DIMENSIONAL APPROACH. [PART] I. Fushchich, V. I. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1970. 40p. (CONF-690417-25). Dep. CFSTI (U. S. Sales Only).

From 3rd Conference on Axiomatical Field Theory and Theory of Elementary Particles, Kiev, USSR.

The irreducible representations of the total inhomogeneous De Sitter group $\tilde{P}$ (1,4) are studied. The canonical and noncanonical equations of motion invariant with respect to the group $\tilde{P}$ (1,4) are found. The equation by which it is possible to obtain the increasing mass-spectrum of particles depending on spin and isospin is suggested and, as an indirect result, the equation of motion being the covariant generalization of the Weyl–Hammer–Good equation was derived for a particle with a zero mass. It is shown that the simplest P-, T-, C-invariant equation in a five-dimensional approach is the eight-component one (6.7). The canonical transformations for the equations of the Dirac type are considered. (auth)

26451 REMARKS ON A POSSIBLE DYNAMICAL AND GEOMETRICAL UNIFICATION OF EXTERNAL AND INTERNAL GROUPS OF MOTIONS OF ELEMENTARY PARTICLES AND THEIR APPLICATION TO $SO_{8,1}$ GLOBAL DYNAMICAL SYMMETRY. Gueret, P.; Vigier, J. P. (Univ., Turin). Nuovo Cim.; 67A: 23-8(1 May 1970).

The utilization of a general theorem of Chevalley on homogeneous spaces which carry the motion, proves that very general types of physical displacements commute with "internal" quantum numbers, thus avoiding a well-known difficulty of elementary-particle theory, underlined by Ne'eman. (auth)

26452 THE EVEN CAR-ALGEBRA. Stroermer, Erling (Univ. of Oslo). Commun. Math. Phys.; 16: 136-7(20 Feb 1970).

It is shown that the even CAR-algebra over a separable Hilbert space is *-isomorphic to the CAR-algebra. (auth)

26453 UNBOUNDED FUNCTIONALS ON A GROUP ALGEBRA AND APPLICATIONS TO QUANTUM THEORY. Roepstorff, G. (Univ., Hamburg). Commun. Math. Phys.; 16: 105-22(20 Feb 1970).

A certain class of positive functionals on a group algebra is examined that is pertinent to the induced representations of Frobenius and Mackey. Though these functionals are not bounded in the L^1 norm, continuity still persists to an extent that secures the existence of a continuous group representation obtained from Gelfand's construction. The theory thus developed provides a new aspect of both the "improper states" in quantum theory and the induced representations of groups. The method is applied to the Poincaré group and it is shown that the representations, in which particles can be accommodated, are determined up to unitary equivalence by unbounded functionals of a simple structure. It is stressed that representations describing an infinitely degenerate vacuum emerge from mass nonzero representations as the mass tends to zero. (auth)

26454 NETS OF C*-ALGEBRAS AND CLASSIFICATION OF STATES. Haag, R. (Univ., Hamburg); Kadison, R. V.; Kastler, D. Commun. Math. Phys.; 16: 81-104(20 Feb 1970).

The concept of locality in quantum physics leads to mathematical structures in which the basic object is an operator algebra with a net of distinguished subalgebras (the "local" subalgebras). Such nets provide a classification of the states of this algebra in equivalence classes determined by local or asymptotic properties. The corresponding equivalence relations are natural generalizations of the (more stringent) standard quasiequivalence relation (they are also useful for classifying states by their properties with respect to automorphism groups). After discussing general nets from this point of view more specialized nets (funnels of von Neumann algebras) are investigated with special emphasis on their locally normal states. (auth)

26455 INFINITELY DIVISIBLE REPRESENTATIONS AND POSITIVE DEFINITE FUNCTIONS ON A COMPACT GROUP. Parthasarathy, K. R. (Univ. of Manchester, Eng.). Commun. Math. Phys.; 16: 148-56(20 Feb 1970).

A complete description of the infinitely divisible positive definite functions on a compact group is given. Their relation to infinitely divisible representations is also discussed. (auth)

26456 OPERATIONAL APPROACH TO ALGEBRAIC QUANTUM THEORY. I. Edwards, C. M. (Queen's Coll. Oxford). Commun. Math. Phys.; 16: 207-30(11 Mar 1970).

Recent work of Davies and Lewis has suggested a mathematical framework in which the notion of repeated measurements on statistical physical systems can be examined. An examination is made of their formulation in the abstract and its application to the C*-algebra model for quantum mechanics. In particular, a study is made of the notion of the restriction of a physical system and a definition, which coincides with the usual definition in the C*-algebra model, is formulated. (auth)

26457 NONLINEAR REALIZATIONS OF THE GROUP SU(2). Mickelsson, J.; Niederle, J. (International Centre for Theoretical Physics, Trieste, Italy). Commun. Math. Phys.; 16: 191-206(11 Mar 1970).

The nonlinear realizations of compact connected Lie groups are considered mainly from the point of view of algebraic topology. In particular, all homogeneous spaces of the group SU(2) are listed, the construction of a few nonlinear realizations of SU(2) is given and the orbit structure of linear and nonlinear realizations is discussed. (auth)

26458 REPRESENTATIONS AND EXTENSIONS OF JORDAN ALGEBRA. Ravatin, J.; Immediato, H. (Faculte des Sciences, Lyon). Commun. Math. Phys.; 16: 184-90(11 Mar 1970). (In French).

A study is made on polynomial algebras defined from Jordan algebras. The consideration of * continuous representations of a Jordan algebra leads to a general theorem for the decomposition of cyclic representations. (auth)

26459 ALGEBRAIC SPECTRUM CONDITION. Kraus, K. (Univ., Marburg, Ger.). Commun. Math. Phys.; 16: 138-41 (20 Feb 1970).

A condition, necessary and sufficient for the existence of a vacuum representation with positive energy of the quasilocal algebra, is formulated. (auth)

26460 RENORMALIZABLE MODELS WITH SIMPLE SYMMETRY BREAKING. I. SYMMETRY BREAKING BY A SOURCE TERM. Symanzik, K. (Deutsches Elektronen-Synchrotron, Hamburg). Commun. Math. Phys.; 16: 48-80(11 Feb 1970).

If to a Lagrangian density with invariance under a continuous group of linear transformations of the fields a term linear or bilinear in the fields is added, the symmetry is in general reduced and the currents associated with the original symmetry are only partially conserved. If the theory without the added term is renormalizable, the theory with that term also is, and the needed renormalization conditions are the essential content of the appropriate Ward–Takahashi–Kazes–Rivers identities. The case of symmetry breaking by a term linear in Bose fields (source term) is here analyzed completely, in particular with respect to the nonsymmetric limit of vanishing source term, a particular Goldstone mode, and with respect to properties of the ground state energy density as a function of the strength of the source term. Induced and spontaneous breaking of a discrete symmetry are also treated. (auth)

26461 $SO^+(n,1)$-INVARIANT FINITE-COMPONENT WAVE EQUATIONS AND REFLECTION INVARIANCE. Mathews, P. M. (International Atomic Energy Agency, Trieste, Italy). J. Math. Phys. (N. Y.); 11: 1360-4(Apr 1970).

First-order finite-dimensional equations of the generalized Bhabha type in a space with n spacelike and one timelike dimensions are considered. It is observed that invariance under the connected part $SO^+(n, 1)$ of the pseudo-orthogonal group in this space requires the use of a wavefunction transforming according to a representation of the larger group $SO^+(n + 1, 1)$. It is shown that though the wavefunction [and each part of it obtained by reduction with respect to $SO^+(n, 1)$] transforms into itself under the strong reflection R also, nevertheless the wave equation in an odd-dimensional space $(n + 1 = 2k + 1)$ may or may not be invariant under R, when the wavefunction employed transforms irreducibly under the connected group $SO^+(n + 1, 1)$. Thus, contrary to the suggestion in the recent literature, where specific equations are considered, the mere fact of oddness of the dimension of the space does not force the use of representations reducible with respect to the latter group (the matter is representation dependent). It is shown, however, that irrespective of the representation used and of the dimension of the space, the equation is invariant under a transformation Θ, defined as a combination of an improper transformation which reverses the sign of time and another improper transformation of reflection in any hyperplane in the spacelike variables. It is suggested that TCP in an arbitrary space be identified with Θ rather than with R, which simple reverses the sign of all coordinates. (auth)

26462 STRONG COUPLING SOLUTION TO SCHROEDINGER EQUATION: THE MIXING OF STATES. Garrido, L. M.; Navarro, L. (Instituto de Fisica Teorica, Barcelona. GIFT, Barcelona). J. Math. Phys. (N. Y.); 11: 1377-81(Apr 1970).

Some ideas that can be useful to solve Schrödinger equations in the case when the Hamiltonian contains a large term are given. An expansion of the solution is obtained in reciprocal powers of the large coupling constant. The procedure followed consists in considering that the small part of the Hamiltonian engenders a motion adiabatic to the motion generated by the large part of the same. (auth)

26463 BRANCHING LAWS, INNER MULTIPLICITIES, AND DECOMPOSITION OF CLASSICAL GROUPS. Wong, M. K. F. (St. Louis Univ.). J. Math. Phys. (N. Y.); 11: 1489-95(Apr 1970).

A method was found whereby the inner multiplicity of all classical groups [all irreducible representations of SU(n) and SO(2k + 1) and some simple irreducible representations of SO(2k) and Sp(2k)] can be obtained easily from the branching laws of Weyl (unitary), Boerner (orthogonal), and Hegerfeldt (symplectic). Once the inner multiplicity is known, the same formula can be used again to obtain the decomposition of a classical group into its subgroups without any restriction. Finally, since the inner multiplicity is connected to the outer multiplicity through the Racah–Speiser lemma, this method enables us to obtain the Clebsch–Gordan series for the direct product of all classical groups. (auth)

26464 BRANCHING RULES FOR $U(n) \supset SO(n)$. Brunet, M.; Resnikoff, M. (State Univ. of New York, Buffalo). J. Math. Phys. (N. Y.); 11: 1471-3(Apr 1970).

Using Littlewood's theorem, we derive branching rules for the restriction of U(n) to the special orthogonal group SO(n), for the case of a 3-row Young diagram. The special cases n = 4, 5 are treated by use of Murnaghan's modification rules. (auth)

26465 REDUCTION OF THE DIRECT PRODUCT OF REPRESENTATIONS OF THE POINCARE GROUP. Moses, H. E. (Air Force Cambridge Research Labs., Bedford, Mass.). J. Math. Phys. (N. Y.); 11: 1219-34(Apr 1970).

The direct product of two representations of the Poincaré group is expanded into representations of the Poincaré group in the general case that the factors of the direct product may have any mass, whether real, zero, or imaginary, and the total energy may be indefinite. The representations of the Poincaré group, which appear in the expansion of the direct product, have masses which run through a continuous spectrum of real and imaginary values and are irreducible in terms of the mass and sign of energy (for real mass), but are reducible in terms of the infinitesimal generators of the little groups. To obtain the expansion in terms of irreducible representations, one need only reduce the infinitesimal generators of the little groups. This reduction is carried out for the real mass components and, in principle at least, can be carried out for the infinitesimal generators of the little groups for the imaginary mass components. The factors of the direct product and the representations which appear in the expansion are expressed in terms of a particular momentum representation called "the standard helicity representation" which enables one to use a uniform notation for all masses, whether real, zero, or imaginary. The properties of these representations are summarized. (auth)

26466 TENSOR OPERATORS IN Sp_4 AND SO_5. Holman III, W. J. (Middle East Technical Univ., Ankara). Nuovo Chim. 66A: 619-43(1 Apr 1970).

The classification program of Biedenharn and his collaborators for the tensor operators of U_n is extended to those of Sp_4, the spinor covering group of SO_5, by considering these tensor operators as embeddings in those of U_4. By means of this embedding and the subgroup decomposition $U_4 \supset Sp_4 \supset Sp_2 \times Sp_2$ the essential results of Biedenharn's program are obtained for the Sp_4 case, i.e., the resolution of the multiplicity problem by the embedding of Sp_4 operators in those of the orbital group $Sp_4 * Sp_4$ and the factorization lemma. Finally, the general tensor operator in $Sp_4 * Sp_4$ is explicitly constructed by means of a calculus of boson operators so that the general Wigner coefficient of Sp_4 and SO_5 may be written down immediately. (auth)

Applications (Electromagnetic and Weak)

26467 CROSSING SYMMETRY IN THE O(4,2) FORMULATION OF THE DIRAC THEORY. Barut, A. O.; Cordero, P.; Ghirardi, G. C. (International Atomic Energy Agency, Trieste, Italy). Phys. Rev., D; 1: 536-41(15 Jan 1970).

The formulation of the Dirac theory based on the group O(4,2), in which an internal additive quantum number n appears, distinguishing particles and antiparticles, is discussed in detail. The substitution law then becomes an analytic continuation in n. (auth)

26468 REDUCTION OF COMPLEX ELECTROMAGNETIC FIELDS TO THE IRREDUCIBLE REPRESENTATIONS OF THE INHOMOGENEOUS LORENTZ GROUP. Rajput, B. S. (Kurukshetra Univ., India). Nuovo Chim. 66A: 517-35(1 Apr 1970).

The reduction of the wave function which transforms as electromagnetic fields to the irreducible representation of proper, inhomogeneous, orthochronous Lorentz group is studied. The electromagnetic fields are expanded into the modes with the amplitudes as wave functions for massless particles of spin 0 and 1. The values of electromagnetic fields in terms of these expansions are calculated as the solution of Maxwell's equations in free space with and without the source. In the presence of source, the expansions for longitudinal and transverse electric and magnetic fields are derived and it is proved that in electromagnetic waves the horizontal component of the magnetic field is always zero, while in the absence of source the two types of circular polarizations of electromagnetic waves are discussed by proving that only spin-1 wave functions contribute to the electromagnetic fields in this case. In the end the second quantization of the electromagnetic fields on replacing the wave function and their complex conjugates by destruction and the construction operators respectively is studied. (auth)

26469 MODEL UNIFYING QUARKS AND LEPTONS ACCORDING TO SAKATA AND YUKAWA, IN THE GLOBAL DYNAMICAL GROUP SO(6,1). Gueret, Philippe; Vigier, Jean-Pierre (Paris Univ.). Compt. Rend., Ser. B; 270: 653-6 (9 Mar 1970). (In French).

To explain the properties of the weak interactions of elementary particles, Sakata and Yukawa have proposed an empirical relation between four fundamental fields and four leptons. This relation is considered as the result of the total dynamical symmetry SO(6,1), the Cabibbo angle being the result of the perturbation of the weak symmetry by the electromagnetic field. (France)

Applications (Strong)

26470 (CALT-68-244) SYMMETRY VIOLATION IN HADRON PHYSICS. Gell-Mann, Murray (California Inst. of Tech., Pasadena). Aug 1969. Contract AT(11-1)-68. 37p. Dep. CFSTI.

SU(3) × SU(3) symmetry, its violation by the strong interaction, and possible connections with weak and electromagnetic effects are studied. Also the breaking of scale invariance by the strong interaction and the possible relations between scale-invariance violation and SU(3) × SU(3) violation are considered. (J.F.P.)

26471 PCAC AND THE CHIRAL COMMUTATION RELATION. Lam, C. S. (McGill Univ., Montreal). Lett. Nuovo Cim.; 3: 409-11(28 Mar 1970).

It is shown that under appropriate assumptions the SU(2) chiral commutation relation follows from the operator PCAC condition, which is given. The assumptions are stated and the proof is given. Pion fields are considered. (J.F.P.)

26472 GENERALIZED ALGEBRAIC MASS FORMULAS. I. Dickens, E. D. Jr.; Levine, A. D. (West Virginia Univ., Morgantown). J. Math. Phys. (N. Y.); 11: 1144-6(Apr 1970).

It is shown that the SL(2, C)-Poincaré associative algebraic model of Böhm can be extended without essential difficulty to an SL(2, C)-de Sitter model which gives rise to a meson mass formula with both spin and isospin dependence. (auth)

26473 REPRESENTATIONS OF NONCOMPACT SEMISIMPLE LIE GROUPS. Joseph, David W. (Univ. of Nebraska, Lincoln). J. Math. Phys. (N. Y.); 11: 1249-71(Apr 1970).

A method is presented for the construction of unitary representations of semisimple Lie groups (or, more precisely, of the corresponding algebras), proceeding directly from the commutation relations among the canonical generators $e_{\pm\alpha}$ and h_α. In the case of the orthogonal groups, the correspondence between the canonical generators and the more usual tensor generators is written down explicitly. It is shown how this method can be used to construct a certain class of representations (bounded above or below) of the Lie algebras of the noncompact groups SU(p,q) and SO(p,q), which arise in the dynamical group treatment of certain physical systems. (auth)

Field Theories

General

26474 (AD-684200) UNIFIED FIELD THEORY–GENERAL RELATIVITY–GRAVITATION THEORY–COSMOLOGY. VOLUME I. Report Bibliography, February 1961–August 1968. (Defense Documentation Center, Alexandria, Va.). Feb 1969. 204p. (DDC-TAA-UFT-1). CFSTI.

This annotated bibliography of 159 unclassified and unlimited citations of documents in the DDC collection explores the general relativity-gravitation theory-cosmology facet of the current research for mathematical solutions and theoretical explanations of Einstein's equations of unified field theory. References dealing with gravimetrics and gravity anomalies, hadron physics, electrodynamics, and atomic fragment dynamics have usually been omitted from this volume unless the work was also closely related to stellar dynamics and cosmology. This bibliography is arranged in accession number (AD-number) sequence. Computer prepared indexes by corporate author, personal author, report number and title are included. Alphabetical title listings are also displayed under specific topics such as gravitational collapse and gravitational radiation. (auth)

26475 HIGHER-DIMENSIONAL FIELD THEORY. Ahner, Henry F. (Adelphi Univ., Garden City, N. Y.); Anderson, James L. Phys. Rev., D; 1: 488-99(15 Jan 1970).

An attempt to construct a theory that links the macroscopic and microscopic properties of matter is presented. This is done using a space of more than four dimensions. Equations for microscopic-particle fields are investigated in a fixed six-dimensional metric space. The topology of the space is solely responsible for the quantization of mass and charge. The metric contains terms which transform like the Yang-Mills B field. These terms appear appropriately in all particle equations. Without the B field, the symmetry group of the theory is P × SU(2)/Z(2). The presence of the B field lowers this symmetry. Particle mass spectra are presented for six-dimensional scalar, spinor, and vector fields, and a coupling-constant ratio is predicted. The later part of the paper deals with the cosmological implications of the microscopic model presented in the first part of the paper. It is shown that Einstein's equations for the metric are consistent if a massless cosmological vector field is introduced. A critique of previous higher-dimensional field theories along with a summary of the results of an eight-dimensional theory is given. Since all symmetries dealt with result as approximations to the equations of the model, the no-go theorems are not applicable. Nevertheless, the six- and eight-dimensional models contain the shadows of the $P \times SU(2)/Z(2)$ and $P \times SU(3)/Z(3)$ symmetries in all particle-field representations. (auth)

26476 STABILITY OF TIME-DEPENDENT PARTICLELIKE SOLUTIONS IN NONLINEAR FIELD THEORIES. I. Anderson, D. L. T.; Derrick, G. H. (Univ. of St. Andrews, Fife, Scotland). J. Math. Phys. (N. Y.); 11: 1336-46(Apr 1970).

The stability of time-dependent particlelike solutions of the form $\psi = \varphi(r)e^{-i\omega t}$ is examined for the nonlinear field $\nabla^2\psi - c^{-2}\partial^2\psi/\partial t^2 = \kappa^2\psi - \mu^2\psi\psi^*\psi$. It is found that such solutions are unstable for all ω. (auth)

26477 EVALUATION OF CERTAIN RADIAL COULOMB INTEGRALS USING SYMMETRY PROPERTIES OF THE COULOMB FIELD. Swamy, N. V. V. J. (Oklahoma State Univ., Stillwater); Kulkarni, R. G.; Biedenharn, L. C. J. Math. Phys. (N. Y.); 11: 1165-71(Apr 1970).

The symmetry properties of the nonrelativistic Coulomb field problem allow one to construct an operator calculus for evaluating matrix elements of the multipole operator r^{-q}. By means of this operator calculus an explanation is given for the vanishing of certain radial integrals treated earlier by Pasternack and Sternheimer as well as for the value of similar integrals occurring in Coulomb excitation. (auth)

26478 SPINORS IN A WEYL GEOMETRY. Adler, Ronald J. (Virginia Polytechnic Inst., Blacksburg). J. Math. Phys. (N. Y.); 11: 1185-91(Apr 1970).

It was noted by London in 1927 that a mathematical connection exists between the unified field theory of Weyl and the old quantum theory of Bohr. It is demonstrated that a Dirac electron in an electromagnetic field described by the Weyl formalism appears to couple to the field via the usual minimal coupling recipe. It is generally acknowledged that the Weyl theory is unsatisfactory for describing macroscopic electromagnetic phenomena. The objections, however, may not be entirely applicable on a quantum mechanical scale. (auth)

Quantum Field Theory

Refer also to abstracts 26399, 26433, 26454, 26471, and 26564.

26479 (NYO-3829-48) INDEFINITE METRIC AND STATIONARY EXTERNAL INTERACTIONS OF QUANTIZED FIELDS. Schroer, Bert (Pittsburgh Univ., Pa. Dept. of Physics); Swieca, Jorge Andre (Sao Paulo Univ. (Brazil)). Mar 1970. Contract AT(30-1)-3829. 19p. Dep. CFSTI.

The necessary modifications of the state space for quantum fields interacting with strong stationary external fields are discussed. In addition to the introduction of indefinite metric the possibility of having positive metric without a vacuum state is discussed. (auth)

26480 AN AMUSING PARADOX INVOLVING TACHYONS. Root, R. G.; Trefil, J. S. (Univ. of Illinois, Urbana). Lett. Nuovo Cim.; 3: 412-14(28 Mar 1970).

A causal paradox involving tachyons is described. The resolution of this paradox is discussed; and some consequences about the appearance of tachyon events as seen by different observers are described. (J.F.P.)

26481 PHYSICAL INTERPRETATION OF COMPLEX-ENERGY NEGATIVE-METRIC THEORIES. Gleeson, A. M.; Sudarshan, E. C. G. (Syracuse Univ., N. Y.). Phys. Rev., D; 1: 474-88(15 Jan 1970).

It has long been held that the divergences of field theory could be removed if the theory was formulated on a Hilbert space with an indefinite metric. The difficulty of this approach was that the theory then possessed channels with negative probability and therefore violated unitarity. In a recent paper, Lee and Wick have observed that this difficulty could be eliminated if negative-metric states had complex energy. A model is produced which shows several of the difficulties associated with the Lee-Wick proposal. The existence of complex energies leads to interpretation difficulties and, in higher sectors, does not completely solve the unitarity problem. The model is used to show how the Lee-Wick conjecture can be extended to overcome the difficulties that are produced. The physical meaning of "good" theories with an indefinite metric is described. (auth)

26482 RENORMALIZATION OF THE AXIAL-VECTOR VERTEX IN SPINOR ELECTRODYNAMICS. Kim, C. W.; Repko, W. W.; Sato, A. (Johns Hopkins Univ., Baltimore). Phys. Rev., D; 1: 434-41(15 Jan 1970).

In the usual method of regularization, the regulator axial-vector current is not conserved. Consequently, the regularized axial-vector current does not, in general, satisfy the ordinary divergence equation derived by using field equations. The anomalous axial-vector divergence equation of spinor electrodynamics is shown to be related to this difficulty of regularization. Using the chiral-invariant regularization and the generalized renormalization procedure developed previously, it is shown how to obtain an axial-vector vertex which obeys the normal Ward-Takahashi identity and is renormalizable to all orders of perturbation theory. The general argument is illustrated by an explicit calculation of the fourth-order contribution to the axial-vector vertex from the anomalous triangle loop diagram. It is also observed that the renormalized axial-vector vertex, which is well behaved from the point of view of perturbation theory, violates the requirement of generalized unitarity. (auth)

26483 INFINITE PRODUCTS AND CONVERGENCE PROPERTIES OF CERTAIN REGGEIZED FEYNMAN DIAGRAMS. Burnett, T. H.; Schwarz, John H. (Princeton Univ., N. J.). Phys. Rev., D; 1: 423-31(15 Jan 1970).

Certain of the Reggeized Feynman diagrams suggested by Kikkawa, Klein, Sakita, and Virasoro that require integrals of infinite products of functions are examined. Methods are formulated for explicitly evaluating the infinite products that occur in simple examples of the class of one-loop nonplanar Reggeized Feynman diagrams whose duals are homeomorphic to a sphere with two windows. The infinite products are found to cause the integrals in these cases to diverge, necessitating a regularizing procedure. The integrals can be given meaning by a redefinition which produces an unwanted pole in the square of the sum of the momenta associated with either window, or with a certain type of smoothing function. (auth)

26484 SIMPLIFIED MULTI-REGGE MODEL AT $t \neq 0$. Frazer, W. R.; Mehta, C. H. (Univ. of California, San Diego, La Jolla). Phys. Rev., D;1: 696-700(15 Jan 1970).

Using the multiperipheral integral equation in a factorizable approximation, a simple model is constructed in which Regge poles and cuts can be studied. In a one-pole version of this model, a bootstrap of a Regge trajectory and residue function is obtained. In a two-pole version, the Pomeranchuk singularity for small t, and its relation to the Amati-Fubini-Stanghellini cut are studied. (auth)

26485 QUANTUM THEORY OF THE INFINITE-COMPONENT MAJORANA FIELD AND THE RELATION OF SPIN AND STATISTICS. Sudarshan, E. C. G. (Syracuse Univ., N. Y.); Mukunda, N. Phys. Rev., D; 1: 571-83(15 Jan 1970).

The quantum theory of the infinite-component Majorana field is formulated. The three classes (slower than light, lightlike, and faster than light) of solutions to this equation and their Wigner classification are discussed. Particular attention is paid to the question of the normalization of the faster-than-light solutions. The current operator is shown to be timelike even for the spacelike solutions, and it is shown to lead to a finite process of emission of light by charged Majorana particles. The quantum theory of the Majorana field is formulated in accordance with the substitution law, and the usual connection between spin and statistics is recovered. (auth)

26486 FORMAL DESCRIPTION OF MEASUREMENTS IN LOCAL QUANTUM FIELD THEORY. Hellwig, K.-E.; Kraus, K. (Univ., Marburg, Ger.). Phys. Rev., D; 1: 566-71(15 Jan 1970).

Ideal measurements in quantum mechanics can be described formally as instantaneous changes of the state vector or, more generally, of the density matrix W. By its lack of covariance, this formalism is not very adequate for relativistic quantum theories such as local field theory. For the latter, a modified formalism is proposed according to which a field measurement in a space-time region C changes the field state W in the future and side cone of C. This proposal is justified by physical considerations. (auth)

26487 DESCRIPTION OF PARTICLES IN SCALAR HYPERPLANE-DEPENDENT FIELD THEORY. I. THE GENERAL FORMALISM. Fleming, Gordon N. (Pennsylvania State Univ., University Park). Phys. Rev., D; 1: 542-8(15 Jan 1970).

The concept of scalar hyperplane-dependent fields is defined on the basis of the author's earlier treatments of the position operators for relativistic particles. Such fields are a special case of fields over homogeneous spaces of the Poincaré group and are related to infinite families of integer spin particles with spin-dependent mass spectra. The intrinsic parity of the particles and degeneracy in the mass spectrum is examined. The Lagrangian formalism, including Noether's theorem, is developed and explored. It is shown that the existence of a Lagrangian formalism yields a normalization condition that is incompatible with the existence of spacelike solutions. The sequel to this paper will consider a specific model with Bose statistics and nondegenerate mass spectrum. (auth)

26488 INDEPENDENCE OF LOCAL ALGEBRAS IN QUANTUM FIELD THEORY. Roos, H. (Univ. Goettingen, Ger.). Commun. Math. Phys.; 16: 238-46(11 Mar 1970).

It is shown that local C*-algebras $U(O_1)$ and $U(O_2)$ associated with spacelike separated regions O_1 and O_2 in the Minkowski space are independent. The proof is accomplished by a theorem concerning the structure of the C*-algebra generated by $U(O_1)$ and $U(O_2)$. (auth)

26489 HOELDER-BANACH SPACE ANALYSIS OF THE BETHE-SALPETER EQUATION. Greenman, J. V. (Univ. of Essex, Colchester, Eng.). Commun. Math. Phys.; 16: 123-35 (20 Feb 1970).

A Hölder-Banach space is found in which the Bethe-Salpeter equation is a compact integral equation as it stands. The properties of the solution are studied in preparation for an analysis of linear field theory models of 3-body amplitudes. In particular the properties of the Regge poles of the solution are studied and the existence and uniqueness of on mass shell scattering amplitudes are proved. (auth)

26490 THEORY OF THE MAGNETODYNAMIC EFFECT ACCORDING TO COLEMAN AND VAN VLECK. Conort, Alain (Paris Univ.). Compt. Rend., Ser. A; 270: 554-6(23 Feb 1970). (In French).

The magnetodynamic effect studied by Coleman and Van Vleck is generalized in the framework of the relativity theory. (auth)

26491 OPERATIONS AND MEASUREMENTS. II. Hellwig, K.-E.; Kraus, K. (Univ., Marburg, Ger.). Commun. Math. Phys.; 16: 142-7(20 Feb 1970).

Results of a preceding paper on pure operations are generalized. The application to local field theory is discussed in some detail. (auth)

26492 A $\lambda\phi^{2n}$ FIELD THEORY WITHOUT CUTOFFS. Rosen, Lon (New York Univ.). Contract AT(30-1)-1480. Commun. Math. Phys.; 16: 157-83(11 Mar 1970).

A self-interacting scalar boson field is considered in two-dimensional spacetime with self-interaction given by an arbitrary Wick polynomial of even degree in the field. It is shown that the field theory can be constructed in a Hilbert space of physical states. The hamiltonian is a positive self-adjoint operator possessing a physical vacuum. The method of proof consists of imposing and then removing three cutoffs: a box cutoff, an ultraviolet cutoff, and a space cutoff. As the first two are removed the resolvents of the cutoff hamiltonians converge uniformly and this leads to the self-adjointness of the spatially cutoff hamiltonians. (auth)

26493 ON ONE MODEL IN THE QUANTUM FIELD THEORY WITH AN EXACT SOLUTION. Tatsunyak, P. I. (Kiev State Univ.). Dopov. Akad. Nauk Ukr. RSR, Ser. A; No. 2, 133-7(Feb 1970). (In Ukrainian).

It is shown that in the model of interaction of the neutral vector field with the derivative of the scalar one consideration of the Lorentz conditions results in an exact solution, the scalar field becoming free one of the zero mass. The Wightman function of the third order is calculated for this model. (auth)

26494 CHIRAL SYMMETRY AND THE GOLDSTONE THEOREM. Lurie, D. (Technion, Haifa, Israel); Solomon, A. I. Lett. Nuovo Cim.; 3: 354-6(14 Mar 1970).

The Goldstone theorem is extended to the case of nonlinear realizations of SU(2) × SU(2) and to SU(3) × SU(3) symmetries. This is done to fill in missing steps in a previous argument. That argument shows that the nonlinear transformations of the fields do not leave the vacuum invariant and this leads to the massless Goldstone bosons. (J.F.P.)

26495 QUANTUM FIELD THEORY ON LIGHTLIKE SLABS. Leutwyler, H. (CERN, Geneva); Klauder, J. R.; Streit, L. Nuovo Chim. 66A: 536-54(1 Apr 1970).

Restricting the support of relativistic quantum fields to lightlike hyperplanes (e.g. $x^0 + x^3 = \text{const}$) examples of such fields are found to exist as well-defined self-adjoint operators with properties however that differ vastly from those of fields on the usual spacelike surfaces. It is shown that on a lightlike hyperplane: (1) the free-field algebra is irreducible (instead of Abelian, and in contrast to what one would expect of data on a characteristic surface) and (2) fields with different masses become unitarily equivalent to spacelike planes). Furthermore the field algebra restricted to the space-time slab between two parallel lightlike planes is always irreducible (while there are counterexamples for spacelike slabs). This is established directly for generalized free fields and it is rederived for Wightman fields in general. (auth)

26496 O(5) HARMONICS AND ABNORMAL SOLUTIONS IN THE BETHE-SALPETER EQUATION. Basu, Debabrata; Biswas, S. N. (Univ. of Delhi). J. Math. Phys. (N. Y.); 11: 1204-9(Apr 1970).

Exact solutions of the covariant Bethe-Salpeter equation in the ladder approximation for two scalar particles bound by a massless particle were obtained for all energies. By using Fock's stereographic projection, the Bethe-Salpeter equation is transformed on to the surface of a 5-dimensional Euclidean sphere and the solutions are then expressed as a series in O(5) harmonics. The normalization condition has been imposed by requiring that the expectation value of appropriate components of the energy-momentum tensor with respect to the bound states is the total energy of the system; it is found that states corresponding to certain values of the quantum numbers do not satisfy the normalization requirement. These are the so-called abnormal asolutions. (auth)

Gravitation and General Relativity

26497 (AD-700651) LORENTZ INVARIANCE IN A GRAVITATIONAL FIELD. Kirkwood, Robert L. (RAND Corp., Santa Monica, Calif.). Jan 1970. 22p. (P-4290). CFSTI.

In any theory of gravity in which free particles move along the geodesics of a four-dimensional metric tensor, a particular class of metrics can be defined which correspond to the fields of Newton's theory of gravity. In these Newtonian fields the metric coefficients which describe intrinsic properties of space and time are clearly separated from those that describe the gravitational field. This separation suggests an invariance in the gravitational field which is quite similar to the usual Lorentz invariance of electromagnetism. The infinitesimal form of the generalized Lorentz transformation is determined by the fact that the three-dimensional geometry remains Euclidean under the transformation. The finite form is determined so that the transformations form a group, and the group is found to be the usual Lorentz group. The transformation is then applied to fields that are not necessarily Newtonian. (auth) (USGRDR)

26498 (JINR-E2-5005) FLAT-SPACE LIMIT OF AN EXACT SOLUTION FOR STATIC GRAVITATIONAL-MASSLESS SCALAR FIELD. Asanov, R. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1970. 7p. Dep. CFSTI (U. S. Sales Only).

The ordinary flat-space limit of the exact static exterior spherically symmetric solution of Einstein equations is obtained when a massless scalar field is present. The result differs from that of Janis, Newman and Winicour, who arrived at the incorrect conclusion that there is an essential singularity in this limit. The essential singularity in scalar field constant G (when $G \to 0$) is found near the origin ($r = 0$) only, where the solution from the very beginning has a singularity in r. No singularity at the space infinity occurs and the exterior solution is unique. (auth)

26499 CURIOUS PROPERTY OF CONFORMALLY RELATED SPACE-TIMES. Kumar, M. M. (Poona Univ., India). Proc. Nat. Inst. Sci. India, Part A, Suppl.; 35: No. 2, 223-31(Jul 1969).

By sticking to Einstein's theory and making use of the conformal transformation $g_{ij} = e^{2\sigma} g_{ij}$ and by choosing suitable conformal factors, field equations, looking like the field equations of Brans and Dicke (1961) and gravitational equations of Hoyle and Narlikar (1964, 1966) were obtained. The resemblance is found to be extended to the propagator equations also in the two theories. (auth)

26500 AN EXPERIMENTAL TEST OF THE SINGLE CHANNEL LOVELACE-WAGNER-VENEZIANO MODEL. Loos, L. L.; Fuchs, N. H.; Gutay, L. J.; Scharenguivel, J. H. (Purdue Univ., Lafayette, Ind.). Phys. Lett.; 31B: 470-4(30 Mar 1970).

The off-mass-shell behavior of the $\pi\pi$ amplitude predicted by the Lovelace-Wagner-Veneziano model implies that the forward-backward asymmetry term in pion production by one pion exchange vanishes for certain values of momentum transfer. A test of this prediction for the region $0.6 < \sqrt{s} < 0.9$ ($\sqrt{s}$ is the dipion effective mass) was made by analyzing the $\pi\pi N$ final state. Substantial agreement between experiment and theory was found. (auth)

26501 ASYMPTOTIC DEFLEXION OF A LIGHT RAY IN A KERR FIELD. Martucci, G.; Modugno, M. (Univ., Florence). Lett. Nuovo Cim.; 3: 553-4(25 Apr 1970).

The geodesics with a large value of the smallest distance from the central singularity are studied for the Kerr family of gravitational fields. It is found that the calculated deflections do not depend on the initial direction of the photon. (J.F.P.)

26502 CONFORMAL FRAMES AND FIELD EQUATIONS IN A CONFORMAL THEORY OF GRAVITATION. Islam, Jamal N. (Inst. for Advanced Study, Princeton, N. J. Univ. of Cambridge, Eng.). Proc. Cambridge Phil. Soc.; 67: 397-414 (1970).

Some aspects of the field equations of the conformal theory of gravitation put forward by Hoyle and Narlikar are studied. The field equations are conformally invariant and one can use a particular conformal frame to simplify the equations, since all conformal frames are regarded as physically equivalent. However, some conformal frames may be unsuitable in some regions of space-time, and with the use of such a frame one may get an unphysical solution. The use of conformal frames and the difficulties involved are illustrated by considering a given physical situation in two different conformal frames. The physical situation is that of two isolated particles. A static solution for this situation is obtained in both frames, and it is shown that a property that is quite unphysical in one frame transforms into a physically reasonable property in the other. The existence of a static solution for two particles would seem to imply that gravitation is repulsive at short distances in this theory. However, the static solution displays singular surfaces enclosing the particles for which there seems no obvious physical interpretation. It is possible that it is intrinsic in the nature of particles to produce such singular surfaces. (auth) (UK)

26503 ON THE ANALYTICITY OF STATIC VACUUM SOLUTIONS OF EINSTEIN'S EQUATIONS. Mueller zum Hagen, H. (King's Coll., London). Proc. Cambridge Phil. Soc.; 67: 415-21 (1970).

It is shown that around each point of a C^3 static vacuum spacetime there is a neighborhood in which the metric is, in a certain suitable coordinate system, analytic. If two of these neighborhoods overlap, then the transformation between these suitable coordinate systems is analytic (in the overlapping domain). (auth) (UK)

26504 GRAVITATIONAL WAVES RADIATED FROM TWO-BODY SYSTEMS. Ezawa, Zyun F.; Yamaguchi, Yoshio (Tokyo Univ.). J. Phys. Soc. Jap.; 28: 1083-7(Apr 1970).

Based on the linearized approximation to Einstein's equation, gravitational energy losses and their spectral decompositions are calculated for the two-body system interacting with each other through Newtonian force. These calculations are analogous to synchrotron radiation from an electron in the Coulomb field or a magnetic field. (auth)

26505 EINSTEIN TENSOR AND GENERALIZATIONS OF BIRKHOFF'S THEOREM. Goenner, Hubert (Univ., Goettingen, Ger.). Commun. Math. Phys.; 16: 34-47(11 Feb 1970).

The Einstein tensors of metrics having a 3-parameter group of (global) isometries with 2-dimensional non-null orbits $G_3(2,s/t)$ are studied in order to obtain algebraic conditions guaranteeing an additional normal Killing vector. It is shown that Einstein spaces with $G_3(2,s/t)$ allow a G_4. A critical review of some of the literature on Birkhoff's theorem and its generalization is given. (auth)

26506 INVARIANT REPRESENTATION OF ALL ANALYTIC PETROV TYPE III SOLUTIONS TO THE EINSTEIN EQUATIONS. Brans, Carl H. (Loyola Univ., New Orleans). J. Math. Phys. (N. Y.); 11: 1210-18(Apr 1970).

The results of the application of previously developed techniques to the analysis of the Petrov type III solutions to the vacuum Einstein equations are presented. The procedure involves the computer aided analysis of the Einstein–Petrov equations to the extent that the functions uniquely and invariantly generating all local analytic solutions are determined. For the case of type III it is shown that, relative to a given fixed point in the manifold, all local analytic solutions are uniquely and invariantly determined by six arbitrary analytic functions of one variable and six others of two variables. These functions, called generating functions, thus provide a representation of all such solutions and may be used for the study of the structure of the family of Einstein empty space metrics. (auth)

26507 HIGH SYMMETRY FIELDS AND THE HOMOGENEOUS FIELD IN GENERAL RELATIVITY. Aichelburg, P. C. (International Atomic Energy Agency, Trieste, Italy). J. Math. Phys. (N. Y.); 11: 1330-5(Apr 1970).

The usual definition of a homogeneous field in general relativity implies a space with $R_{iklm} = 0$, thus admitting a group of motions isomorphic to the Poincaré group. After discussing the symmetry group of the homogeneous field in Newtonian space, it is pointed out that there exists no space with $R_{ik} = 0$, which is a "true" field, i.e., $R_{iklm} \neq 0$, and which admits an analogous relativistic group. Then fields, solutions of $R_{ik} = 0$, which define spaces that admit a 4-parameter group of motions locally isomorphic to the groups $T_1 \otimes [T_2 \otimes_s O(2)]$ and $T_1 \otimes [T_2 \otimes_s O(1, 1)]$ are studied. The motion of a test particle in these fields is compared with the motion in the usual homogeneous field. (auth)

26508 SPHERICAL SYMMETRY AND MASS–ENERGY IN GENERAL RELATIVITY. I. GENERAL THEORY. Cahill, Michael E.; McVittie, G. C. (Univ. of Illinois Observatory, Urbana). J. Math. Phys. (N. Y.); 11: 1382-91(Apr 1970).

The mass-energy of spherically symmetric distributions of material is studied according to general relativity. An arbitrary orthogonal coordinate system is used whenever invariant properties are discussed. The Bianchi identity is shown to imply that the Misner–Sharp–Hernandez mass function is an integral of two combinations of Einstein's equations for any energy-momentum tensor and that mass-energy flow is conservative. The two mass equations thus found and the mass function provide a technique for casting Einstein's field equations into alternative forms. This mass-function technique is applied to the general problem of the motion of a perfect fluid and especially to the examination of negative-mass shells and their relation to singular behavior. The technique is then specialized to the study of a known class of solutions of Einstein's equations for a perfect fluid and to a brief treatment of uniform model universes and the charged point-mass solution. (auth)

26509 ANALYSIS OF THE NEWMAN–UNTI INTEGRATION PROCEDURE FOR ASYMPTOTICALLY FLAT SPACE–TIMES. Dixon, W. G. (Cambridge Univ., Eng.). J. Math. Phys. (N. Y.); 11: 1238-48(Apr 1970).

An analysis is given of the procedure of Newman and Unti for solving the vacuum gravitational field equations for all space-times in which $\Psi_0 = O(r^{-5})$. It was found empirically by Newman and Unti that when the nonradial equations and three of the u-derivative equations have been satisfied to their lowest nontrivial order in r^{-1}, they are then found to be identically satisfied to all orders. A general proof of this result is given which avoids the need for direct verification. (auth)

26510 SPHERICAL SYMMETRY AND MASS–ENERGY IN GENERAL RELATIVITY. II. PARTICULAR CASES. Cahill, Michael E.; McVittie, G. C. (Univ. of Illinois Observatory, Urbana). J. Math. Phys. (N. Y.); 11: 1392-1401(Apr 1970).

A solution of Einstein's field equations for the motion of a spherically symmetric distribution of perfect fluid is investigated in an isotropic comoving coordinate system. It is shown that this solution includes all solutions discussed by McVittie in which the density depends on both the radial and time coordinates. Necessary and sufficient conditions for the solution to be singularity-free and for the density and pressure to be nonnegative and monotonically decreasing from the center of the material outwards to an outer boundary are found. The material is surrounded by empty space. Examples of both oscillating and "bouncing" solutions are produced. It is shown that the outer boundary of the material never penetrates the Schwarzschild radius in all singularity-free solutions. (auth)

26511 TWO EARLY UNIFIED FIELD THEORIES. Klotz, A. H. (Univ. of Sydney). J. Aust. Math. Soc.; 10: 136-40(1969).

Einstein's first presentation of four dimensional theory is compared with Levi–Civita's reformulation, and found incompatible. For $\lambda_i^\mu = \lambda_i^\mu$ as a special case, the Ricci coefficients vanish identically, however Einstein's field tensor $F_{ij} = \lambda_i^\alpha \lambda_j \Gamma^\sigma_{\alpha\beta;\sigma}$ and is nonzero which in Levi–Civita's theory corresponds to the absence of electromagnetic fields. (auth)

26512 A UNIFIED TREATMENT OF THE KERR AND VAIDYA SOLUTIONS IN GENERAL RELATIVITY. Misra, M. (Dublin Inst. for Advanced Studies). Proc. Roy. Irish Acad., Sect. A; 69: 39(1970).

Axially symmetric solutions of Einstein's field equations have been given by Kerr (1963) (for a vacuum) and Vaidya (1963) (for radiation). Their solutions are presented in a unified treatment based on the Schild–Kerr matric. (auth) (UK)

Scattering Theory

Refer also to abstracts 26416, 26673, and 26682.

26513 (AD-690080) THE GENERALIZED CLUSTER DECOMPOSITION OF THE S-MATRIX. Research Communication No. 100. Jacobson, Donald A. (McDonnell Douglas Corp., Huntington Beach, Calif. Douglas Advanced Research Labs.). Apr 1969. 55p. CFSTI.

The cluster decomposition of the S-matrix for arbitrary measurements (including non-asymptotic measurements) is derived from a generalized first cluster property. The corresponding connected part of the S-matrix is then shown to satisfy a connected unitarity relation containing terms not present when only asymptotic measurements are considered. (auth) (USGRDR)

26514 (AD-700141) SUPERCONVERGENCE AND CURRENT ALGEBRA FOR A $^1/_2$-SPIN TARGET. II. Boiti, M.; Pempinelli, F.; Zandron, O. (Turin Univ. (Italy). Istituto di Fisica). Jan 1968. 32p. (AFOSR-70-147-TR). CFSTI.

A study is made of the analytic properties in the Khuri plane of the invariant amplitudes, that define a scattering process of a 1-spin "current" on a $^1/_2$-spin target. Some current algebra and superconvergence identities are obtained. The latter are derived in two different ways. The formalism developed is used to rederive the well known low energy theorem for the Compton scattering. (auth) (USGRDR)

26515 THE S-MATRIX THEORY OF DIFFERENTIAL EQUATIONS WITH INTEGRABLE POTENTIAL. Krein, M. G.; Melik-Adamyan, F. E. (Erevan State Univ.). Dokl. Akad. Nauk Arm. SSR; 46: 150-5(1968). (In Russian).

A second-order Hermitian matrix function was examined, deriving a certain unitary function, designated as its S-matrix. By means of a simple substitution which preserves the integrability of the potential and of the S-matrix of the equation, the canonical differential equation could be transformed into one possessing a potential which satisfies the condition of Hermitian character; this potential is designated as a normalized one. Results given in an earlier paper of one of the authors were generalized, deriving the conditions which indicate that the unitary n-th order matrix is the S-matrix of a given canonical differential equation with an integrable potential. (TTT)

26516 SCATTERING THEORY: UNITARITY, ANALYTICITY, AND CROSSING. Martin, Andre. Lecture Notes in Physics. Volume 3. Berlin and Heidelberg; Springer-Verlag (1969). 130p.

The analyticity and unitarity of the S-matrix are described. Control of the magnitude of the amplitudes, positivity, and elastic unitarity are treated, and the extension of the analyticity domain obtained from field theory using positivity is considered. Bounds on the scattering amplitude are obtained. (J.F.P.)

26517 BOUNDS ON THE PHASE OF THE FORWARD SCATTERING AMPLITUDE AND THE POMERANCHUK THEOREM. Mickens, R. E. (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-2098. Lett. Nuovo Cim.; 3: 428-32(28 Mar 1970).

Since the proofs of the Pomeranchuk theorem make an assumption about the phase of the forward scattering amplitude, which is not established from any of the basic axioms of quantum field theory, some bounds on the phase of this amplitude are investigated. These bounds follow from bounds on the total cross section. The case where the total cross section is constant at infinite energy is discussed. (J.F.P.)

26518 A SELF-CONSISTENT CONDITION FOR VENEZIANO AMPLITUDES. Agnese, A.; La Camera, M.; Wataghin, A. (Univ., Genoa. Istituto Nazionale di Fisica Nucleare, Genoa). Lett. Nuovo Cim.; 3: 433-6(28 Mar 1970).

Some new relations are obtained which must be satisfied by the coefficients of the trajectories $\alpha_x(s)$, $\alpha_y(t)$, and $\alpha_z(u)$ appearing in the Veneziano formula. The method used is different from the Adler self-consistent condition. (J.F.P.)

26519 RESONANCE CROSSING-SYMMETRIC CONFLUENT-HYPERGEOMETRIC FUNCTION MODEL WITH COMPLEX TRAJECTORIES. Dash, J. W.; Bali, N. F.; Coon, D. D. (Univ. of Washington, Seattle). Contract AT(45-1)-1388. Nuovo Cim.; 67A: 54-70(1 May 1970).

A model employing confluent hypergeometric functions is presented which admits complex trajectories while satisfying many requirements of S-matrix theory, and a theorem is proved relating the average asymptotic spacing of zeros and poles of a meromorphic function to its asymptotic behavior. (auth)

26520 SYMMETRICAL VERTEX AND THE TREE STRUCTURE OF DUAL AMPLITUDES. Drummond, I. T. (Cambridge Univ., Eng.). Nuovo Cim.; 67A: 71-87(1 May 1970).

Various generalizations of the method of Fubini and Veneziano for factorizing dual amplitudes are considered. One method dispenses with the need for scalar excitations and fits naturally with the derivation of a symmetric vertex. This vertex is derived initially with mass-shell restrictions. It is suggested however, on the basis of an examination of the four- and five-point amplitudes that the vertex may be used off the mass shell along with a suitable propagator to write dual amplitudes as sums over all possible trees. This decomposition would look like a perturbation solution of a field theory. The case of the five-point amplitude shows the necessity of including five-legged contact terms. This suggests that the field theory would be highly nonlinear. (auth)

26521 DUALITY IN OPERATOR FORMALISM. Fubini, S.; Veneziano, G. (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-2098. Nuovo Cim.; 67A: 29-47(1 May 1970).

We propose a form for a dual resonant amplitude in which both duality and factorization are explicitly exhibited. This result is achieved by considering in detail the transformation properties of the operators appearing in the model under the fundamental projective transformation of Koba and Nielsen. (auth)

26522 ON THE REGGEIZED MULTIPERIPHERAL MODEL. Ferrara, S. (CNEN, Frascati, Italy); Mattioli, G. Nuovo Cim.; 67A: 1-12(1 May 1970).

The problem of the convergence of the unitarity series, saturated with Reggeized multiperipheral graphs, is formulated in a clear mathematical way. The asymptotic approximation is extensively treated. (auth)

26523 COVARIANT APPROACH TO KINEMATIC CONSTRAINT RELATIONS FOR HELICITY AMPLITUDES. King, Marcia J.; Kuo, P. K. (Johns Hopkins Univ., Baltimore). Phys. Rev., D; 1: 442-50(15 Jan 1970).

With the aid of a covariant spin formalism, the kinematic constraint equations for helicity amplitudes are studied in a systematic way for all mass configurations, including the case of zero-mass particles. The complete set of constraints at thresholds and pseudothresholds is given in a form convenient for calculation; that is, the coefficients of the helicity amplitudes are simple numerical ones (as opposed, for instance, to D functions). For nonzero-mass particles, the reduction of the constraints in terms of total spin amplitudes is shown to follow. Amplitudes with different values of total spin are not related at thresholds or pseudothresholds. (auth)

26524 TWO-BODY UNITARITY AND THE ASYMPTOTIC DUALITY SERIES. Green, M. B. (Cambridge Univ., Eng.). Phys. Rev., D; 1: 450-5(15 Jan 1970).

The discontinuity of the Regge trajectory obtained recently from a duality series by Kikkawa, Sakita, and Virasoro is investigated. The trajectory is shown to possess all the thresholds corresponding to two-particle intermediate states, i.e., Regge recurrences or daughters. A correction to a linear trajectory is also shown to arise by requiring the Born term (the Veneziano amplitude) to be modified to satisfy two-body partial-wave unitarity near the leading pole in the J plane. This discontinuity is evaluated up to the third two-particle threshold and found to be identical to that obtained from the duality series. Above higher thresholds, such agreement is dependent on the function used to ensure factorization at interval vertices in each term of the duality series. (auth)

26525 ASYMPTOTIC PROPERTIES OF PLANAR DUALITY AMPLITUDES. Kikkawa, K. (Univ. of Wisconsin, Madison); Schwarz, John H. Contract AT(11-1)-881. Phys. Rev., D; 1: 724-6(15 Jan 1970).

Planar duality amplitudes are shown to have Regge asymptotic behavior when $|s| \to \infty$ at any nonvanishing angle to the real axis with t fixed. The asymptotic behavior of the amplitudes in the same s limit with u fixed is also investigated. (auth)

26526 REMARKS ON THE UNITARITY CONDITION IN THE IMPACT-PARAMETER REPRESENTATION. Chew, H. (Clarkson Coll. of Tech., Potsdam, N. Y.). Phys. Rev., D; 1: 719-20 (15 Jan 1970).

The kernel needed in the application of the unitarity condition in the Blankenbecler-Goldberger impact-parameter representation is reduced to a simple sum suitable for numerical work. Brief comments are made on a modified version of the representation. (auth)

26527 STRUCTURE OF REGGE POLES AND THEIR RESIDUES AT t = 0 FOR GENERAL TWO-BODY-TO-TWO-BODY REACTIONS. Wang, Jiunn-ming (Princeton Univ., N. J.); Wang, Ling-lie. Phys. Rev., D; 1: 663-83(15 Jan 1970).

A convenient method is introduced to analyze the requirements imposed by the analyticity of the full helicity amplitudes on the structure of Regge poles and their residues at t = 0 for two-body-to-two-body reactions with general masses and spins. This method shows the structure of daughter trajectories and conspirators clearly. Also, in practice, this method allows the following derivation to be made for reactions with arbitrary spins. (1) The most singular parts of the daughter and conspirator residues at t = 0 are calculated for unequal-mass-unequal-mass reactions and unequal-mass-equal mass reactions. Then, through factorization, the nonvanishing parts of the daughter and conspirator residues are obtained for the equal-mass–equal-mass reactions. They are identified with a one-Lorentz-pole expansion. (2) In calculating the daughter and conspirator residues, the analyticity requirements of both the t-channel and the s-channel helicity amplitudes are satisfied. Therefore, the conspiracy equations are shown to be satisfied explicitly. (3) The restrictions on the slopes of the daughter trajectories are also obtained. Their independence of the external masses and spins is shown. (4) The restrictions on the slopes of the conspirators are also calculated. An interesting new result is obtained: For a trajectory of quantum number M, at t = 0, the trajectories $\alpha_+(t)$ and $\alpha_-(t)$ are equal, and likewise their derivatives up to the (M − 1)th. Before carrying out all these calculations, all the t factors of the Regge residue have to be determined. By introducing a quantum number M in the unequal-mass–unequal-mass reactions, the t factors of the parent as well as the daughter residues are uniquely determined using the conventional method of analyticity and factorization. This quantum number M is identified to be the O(4) M in the equal-mass–equal-mass reactions. It is noted that if the definition of the quantum number M is not affected by the coincidence of $\alpha(t)$ with an integer at t = 0, then the trajectory $\alpha(0)$ will choose sense if $M < \alpha(0)$ and choose nonsense if $M > \alpha(0)$. A discussion is given on the implications for the group-theoretical approach to the Regge-pole theory. (auth)

26528 COUPLED-CHANNEL AMPLITUDES: PHYSICAL EFFECTS AND ANALYTIC STRUCTURE. Lomon, Earle L. (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-2098. Phys. Rev., D; 1: 549-65(15 Jan 1970).

An investigation is made of the effects of an indefinite number of coupled channels on two-particle amplitudes. Central coupling, chain coupling, and combinations of them are considered. Some results are general, while others depend on a generalized potential model. The existence of strong resonance-producing effects is related to zeros of the S matrix. Forms of Levinson's theorem are found for both the amplitude and S-matrix phases. It is shown that if the effective number of coupled channels increases linearly with the energy that (1) the partial-wave S matrix can vanish asymptotically (the usual result is that $S_L \rightarrow 1$); and (2) Regge trajectories rise asymptotically as the square root of the energy. Special results of the MacDowell symmetry are noted for a finite number of coupled channels. With respect to a special (boundary condition) model it is found that Regge trajectories which cross the origin near $L = \frac{1}{2}$ should have much larger slopes than those crossing the origin near L = 1, in agreement with observation. Regge cuts result from the coupling of effective three-body channels. (auth)

26529 HIGH-ENERGY LIMIT OF PRODUCTION AMPLITUDES. Feldman, G.; Matthews, P. T. (Imperial Coll. of Science and Tech., London). Phys. Rev., D; 1: 523-32(15 Jan 1970).

A simplified version of the Bali-Chew-Pignotti amplitude for multi-Regge-pole particle production is given using the recently developed projection-operator technique to construct many-particle states. This amplitude is generalized to a multi-Toller-pole expansion to avoid singularities which otherwise occur when any momentum-transfer variable goes to zero. It is shown how to determine the M value of a Toller pole by measuring the distribution as a function of a Treiman-Yang angle. (auth)

26530 SIMPLY FACTORIZABLE n-POINT AMPLITUDE. Barut, A. O. (Univ. of Colorado, Boulder); Moffat, J. W. Phys. Rev., D; 1: 532-5(15 Jan 1970).

A general n-point amplitude based on tree diagrams which has Regge asymptotic behavior and poles in all channels, but which is not dual, is explicitly factorized, and the coupling of three or more Reggeons is computed. The degeneracy of levels of the factorization of the n-point function is n^2, the same as in the four-point function. Group-theoretical implications are briefly discussed. (auth)

26531 POSSIBLE DIFFICULTY WITH THE "EIKONAL PICTURE" OF HIGH-ENERGY INTERACTIONS. Kantor, P. B. (Case Western Reserve Univ., Cleveland). Phys. Rev. Lett.; 24: 1081-3(11 May 1970).

A heuristic argument suggesting that at high energies the effect of multiple scattering off the energy shell becomes important for an understanding of the propagation of one elementary particle through another is presented. (auth)

26532 HIGHLY SINGULAR POTENTIALS AND RISING REGGE TRAJECTORY. Misra, R. C. (Univ. of New Brunswick, Fredericton). Lett. Nuovo Cim.; 3: 351-3(14 Mar 1970).

Highly singular r^{-4} potentials and the consistency of the finite-energy sum rules are used to show that Regge trajectories rise indefinitely. (J.F.P.)

26533 MITTAG-LEFFLER EXPANSION OF THE S-MATRIX INTEGRAL REPRESENTATION. Minelli, T. A. (Univ., Padua); Zardi, F. Lett. Nuovo Cim.; 3: 369-72(14 Mar 1970).

A formulation of the nuclear resonance problem is given based on a Mittag–Leffler expansion of the S-matrix in its integral form, as given by the Lippman–Schwinger theory. Only the potential scattering case is considered. (J.F.P.)

26534 MANDELSTAM REPRESENTATION FROM THE PARTIAL-WAVE AMPLITUDES. Jengo, R. (Univ., Trieste, Italy. Istituto Nazionale di Fisica Nucleare, Trieste, Italy). Nuovo Chim., 66A: 555-78(1 Apr 1970).

The necessary and sufficient conditions for the partial-wave scattering amplitudes a(l, s) are written in order that the complete amplitude $A(s, t, u) = \Sigma_l\ (2l + 1)a(l, s)P_l(z)$ have the correct analytic properties in s, t and u and the Mandelstam representation be valid. This is done for the case of equal-mass scattering. (auth)

26535 SYMMETRICAL DUALITY VERTEX. Stapp, H. P. (International Atomic Energy Agency, Trieste, Italy). Nuovo Chim. 66A: 497-516(1 Apr 1970).

A symmetrical formula for the on-mass-shell three-particle vertex of the generalized Veneziano model is derived. No attempt is made to isolate the contributions corresponding to the different angular-momentum components of the three particles. (auth)

26536 COULOMB SCATTERING. I. SINGLE CHANNEL. Mulherin, Denis (Manhattan Coll., Bronx, N. Y.); Zinnes, I. I. J. Math. Phys. (N. Y.); 11: 1402-8(Apr 1970).

With the aid of a Coulomb "free propagator" $U_C^{(\pm)}(t)$ constructed from the asymptotic form of the conventional time-independent solution to the scattering problem in a pure Coulomb field, Møller wave operators are shown to exist for general Coulomb-like (Coulomb + short-range) potentials. It is emphasized that when scattering occurs in such long-range fields, one should distinguish three classes of states: the prepared and detected states, the scattering states, and certain asymptotic states which are peculiar to long-range potentials. The existence of the third class as a class distinct from the first suggests a connection between $U_C^{(\pm)}(t)$ and the quantum theory of measurements. (auth)

26537 OFF-SHELL T-MATRIX ELEMENTS IN POTENTIAL SCATTERING. Underhill, J. (Univ. of Liverpool). J. Math. Phys. (N. Y.); 11: 1409-19(Apr 1970).

Derivations of integral equations satisfied by the off-shell extension of the scattering amplitude (in nonrelativistic potential scattering) defined by the Lippmann–Schwinger equation are given. The input information in these equations consists of phase shifts. The derivation is based on the work of R. G. Newton on the inverse scattering problem in potential scattering. (auth)

26538 SOLUTION OF THE PHASE EQUATIONS FOR DIRAC DISTIRBUTIONS, AND SINGULAR PERTURBATIONS OF THE SCHROEDINGER EQUATION. Ronveaux, Andre (Univ. Notre-Dame de la Paix, Namur, Belgium). Compt. Rend., Ser. A; 270: 621-4(2 Mar 1970). (In French).

The matrix Riccati equation describing the phase is solved when the perturbating potential is a linear combination of Dirac distributions. The application to the Schrödinger equation, in the collision theory, allows the perturbed and unperturbed scattering phase shifts of a potential V(r), modified by a Dirac potential $A\delta(r-c)$, to be related. (France)

26539 COLLISION PROBLEMS WITH IDENTICAL PARTICLES. Masnou-Seeuws, F.; Salin, A. (Observatoire de Paris, Meudon, France). J. Phys., B (London); 2: 1274-7(Dec 1969).

Attention is drawn to a method, formulated by Feynman, which gives a straightforward derivation of the cross section in the case of collisions between identical particles. The difficulties encountered in the interpretation of the scattering amplitudes are stressed when the wave function is symmetrized. Ways of avoiding these difficulties are discussed, showing that it is easier to refer to physical experiments with fixed apparatus. (auth) (UK)

26540 ITERATIVE METHOD FOR SOLVING INTERMEDIATE-ENERGY SCATTERING PROBLEMS. Conkie, W. R.; Singh, S. R. (Queen's Univ., Kingston, Ont.). J. Phys., B (London); 2: 1293-9(Dec 1969).

A simple method for solving potential scattering problems was developed. This method requires an accurate determination of the l = 0 wave function. This wave function is then combined with a trial wave function representing the higher partial waves. The parameters in the trial wave function are determined by requiring that the iterated scattering amplitude agree with the uniterated amplitude at certain suitable values of the scattering angle θ. (auth) (UK)

Particle Accelerators

Refer also to abstracts 25234, 25475, and 26397.

26541 (CERN-Trans-70-3) PROJECT FOR THE SLOW EJECTION SYSTEM FOR THE 70 GeV IHEP ACCELERATOR. Myznikov, K. P.; Gridasov, V. I.; Kurnaev, O. V.; (and others) (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). Translation of a Russian report 21p. (In French). Dep. CFSTI (U. S. Sales Only).

The system described is designed for the slow ejection of a proton beam having an energy of 20 to 70 GeV from the IHEP accelerator. The ejection of the protons is carried out with a plateau of the magnetic cycle having a maximal duration of 1.5 s. The ejection system is based on the resonant excitation of radial betatron oscillations. It is found preferable to use a nonlinear third-order resonance. The diagram of the slow ejection system is shown, and the basic parameters of the elements of this system are given. (J.F.P.)

26542 (IFVE-SKU-69-39) INVESTIGATION OF THE SIMULTANEOUS WORK OF THE SPUTTER-ION PUMP, NEM-300, WITH THE VAPOR-OIL UNIT, VA-05-4 AND VN-2 PUMP. Pronin, O. D.; Pogozinskii, V. G. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1969. 17p. (In Russian). Dep. CFSTI (U. S. Sales Only).

This paper presents the results of an investigation of the simultaneous work of the sputter ion pump NEM-300 and the vapor-oil unit VA-05-4 and VN-2 pump with one-way traps. It is shown that about 75% of the hydrocarbon, that slows down the pumping speed of the NEM-300 pump approximately two times, is present in the residual gas. After NEM-300 has worked with the air flux under the pressure of 1 to 2×10^{-5} torr during 20 to 30 minutes, the pumping speed restores and indicates that the pump is cleaned with an intense charge and the pump heating. After 24 hours of pump operation at a pressure of less than 1×10^{-7} to 1×10^{-6} torr, the pumping speed decreases due to the contamination of the hydrocarbon vapor from the vacuum chamber. (auth)

26543 (KFK-tr-307) SUPERCONDUCTING SYNCHROTRON ON THE BASIS OF A MAGNET SYSTEM WITH STATIONARY FIELD. Doynikov, N. I.; Komar, E. G.; Monoszon, N. A.; Rozhdesrvenskii, B. V.; Sivkov, Yu. P. Translated by Rosemarie Corssen (Kernforschungszentrum, Karlsruhe, W. Ger.), from 7th International Conference on High Energy Accelerators, Moscow, August 28–September 2, 1969. 11p. (In German). (CONF-690811-13). Dep. CFSTI (U. S. Sales Only).

Because of the small weight of superconducting electromagnets, the possibility of the field alteration was tested on the synchrotron path by mechanical displacement of the superconducting electromagnets with stationary magnetic fields. Estimations show that for the mechanical displacements, powers are necessary which are smaller by a fraction than for the production of corresponding time-varying fields. Two possible variations of such a synchrotron are investigated: a synchrotron device in which the alteration of the rotating field is produced by synchronous rotation of the electromagnet with a stationary field; and the synchrotron variant with radial countercurrent displacement of adjacent electromagnets. An example of the construction variants of the rotating magnets of an accelerator is given. (J.S.R.)

26544 (KFK-tr-312) LINEAR ION ACCELERATOR WITH HOMOGENEOUS-SPACE STRONG FOCUSING. Kapchinskii, I. M.; Teplyakov, V. A. Translated by Rosemarie Corssen (Kernforschungsanlage, Karlsruhe, W. Ger.), from 7th Conference on High Energy Accelerators, Moscow, August 28–September 2, 1969. 12p. (In German). (CONF-690811-14). Dep. CFSTI (U. S. Sales Only).

Proposals for a linear ion accelerator are discussed. Focusing and acceleration are achieved by an electric high-frequency field produced by a long four-conductor system. The accelerator contains no drift tube. Advantages of the proposed accelerator are simplicity of construction, small diameter, and low injection energy even at high beam intensities. (tr-auth)

26545 (NP-18206) ANNUAL REPORT, 1969. Brearley, N. (ed.) (TRI-Univ. Meson Facility, Vancouver (British Columbia)). Feb 1970. 51p. Dep. CFSTI (U. S. Sales Only).

Topics include organization, plans for the TRIUMF facility, construction, status of the cyclotron and ancillary equipment, safety, the central region cyclotron model, project management and engineering, conferences, reports, staff, financial statement, users groups and committees, and TRIUMF specifications. (W.H.K.)

26546 (ORNL-TM-2925) DESIGN CONSIDERATIONS FOR AN ORELA TARGET USING TANTALUM FOLLOWED BY BERYLLIUM. Booth, R. S. (Oak Ridge National Lab., Tenn.). 31 Mar 1970. 57p. Dep. CFSTI.

The nuclear calculations associated with the design of a neutron source composed of tantalum followed by beryllium for the Oak Ridge Electron Linear Accelerator (ORELA) are presented. Electrons incident on the tantalum converter produce a narrow beam of intense photons which then generate neutrons in the beryllium. The primary considerations associated with this analysis are the size of the beryllium block and the distance between the beryllium block and the tantalum converter. Monte Carlo calculations of the neutron interactions in the beryllium are used to predict the expected neutron intensity at two flight stations as a function of position in the source plane and time-of-arrival (energy) of the neutron flux. The time spread, caused by migration in the beryllium, of a monoenergetic neutron pulse energy is calculated for the same flight stations. The final predicted neutron intensity is compared with a measured neutron intensity from a target system similar to the one designed here. (auth)

26547 (UCRL-Trans-1408) THE "SQUIRREL-CAGE" SYSTEM OF FOCUSSING AN ELECTRON RING IN A COLLECTIVE LINEAR ION ACCELERATOR. Dolbilov, G. V.; Ivanov, I. N.; Perel'shtein, E. A.; Sarantsev, V. P.; Shevtsov, V. F. (Joint Inst. for Nuclear Research, Dubna (USSR)). Translated by R. Addis for Univ. of California, Lawrence Radiation Lab., Berkeley, from report JINR-P9-4737. 9p. (CONF-690811-16). Dep. CFSTI.

From 7th International Conference on High Energy Accelerators, Moscow, USSR.

This article was previously abstracted from the original language and appeared in NSA as 24: 5360. (C.E.S.)

26548 STUDY OF CERTAIN CHARACTERISTICS OF THE ACCELERATED ION BEAM OF THE U-150-2 CYCLOTRON. Irisbaev, K. N. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 4, 64-6(1969). (In Russian).

The trajectory of the ions during the first few orbits of the accelerator was calculated by a graphic method, solving the differential equation of the ion motion in crossed magnetic and electric fields. At great distances, the ion cluster may be widened to an unacceptable level because of the divergence of the extracted beam's trajectory. The beam of the accelerator U-150-2 is at a large distance of 26 m, therefore calculations were made to find the widening with and without a slit diaphragm, determining the phase shift for each orbit. It was found that ions with an initial phase of 0 and 10° at a voltage of 140 to 180 kV between the dees are phase-stable; they experience the highest change at an accelerating voltage of about 160 kV. The phase shift is strongly increased at low voltages because of the large number of orbits; this causes loss of intensity and low ion yields. At high voltages, the ions are shifted toward large positive phases. Often it is enough to find the optimum accelerator field range to ensure phase stability and a stable yield coefficient. (TTT)

26549 POLARIZATION MEASUREMENT IN POLARIZED TARGETS BY THE INTERNAL FIELD. Kuiper, Hajo (Univ., Erlangen-Nuernberg). Z. Phys.; 232: 325-41(1970). (In German).

It is shown how the difficulties with the "Lorentz field" method of Abragam et al., for the measurement of nuclear polarization can be resolved. The observable field shift is derived as a function of nuclear polarization, target shape and some other parameters. For purposes of practical application numerical results are presented for polarized targets of lanthanum magnesium nitrate (1% Nd) having the shape of thin square slabs. (auth)

26550 PNEUMATIC SAMPLE TRANSPORT SYSTEM FOR A NEUTRON GENERATOR. Rurarz, Edward; Sulik, Andrzej (Inst. of Nuclear Research, Swierk, Poland). Nukleonika; 14: 1165-9(1969).

The system operates by pressurized air. Samples encapsulated in Plexiglass containers can be shot back and forth between the neutron generator and the measuring room. The distance being 12 meters, the minimum transport time is approximately 800 ms, and hence radionuclides with half-lives ranging from a few seconds to minutes can be measured. (auth)

26551 ACCELERATED ELECTRON CURRENT IN BETATRON WHEN SPACE-CHARGE IS PRESENT. Scarlat, F. (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz.; 21: 1095-1104(1969). (In Rumanian).

The formula for captured electron current in a betatron is derived. In the treatment, parallel and divergent beams in the presence of space-charge transversal effects are assumed. A constant electron current injection on the equilibrium orbit is considered as an ideal case. In the solution of the equations, a microcanonic type distribution in phase space is used. The influence of the accelerating chamber walls is not included. The main conclusion obtained is that the maximum capture electron current is attainable for parallel beams with zero emittance and that it increases linearly with the donut admittance and with the third power of injection energy. (auth)

26552 THIRD-ORDER ABERRATIONS OF AN ELECTROSTATIC QUADRUPOLE LENS FOR A MODIFIED BELL-SHAPED MODEL. Kanaya, Koichi; Okayama, Shigeo (Electrotechnical Lab., Tokyo). Denki Shikensho Iho; 33: 1259-78(1969).

The third order aberration coefficients of an electrostatic quadrupole lens to be immediately applicable to a multi-stage quadrupole lens system are formulated in terms of the two parameters of the lens strength function and quarter-width value in a modified bell-shaped model. These coefficients are graphically plotted and the important relationships are analytically deduced. (auth)

26553 SPHERICAL ABERRATION OF ELECTROSTATIC SYMMETRICAL QUADRUPOLE DOUBLET. Okayama, Shigeo; Kawakatsu, Hisazo; Kanaya, Koichi (Telectrotechnical Lab., Tokyo). Denki Shikensho Iho; 33: 1279-89(1969).

Applying the results obtained by the trajectory method for an electrostatic quadrupole lens to the symmetrical doublet under the special condition of "pseudo-stigmatic," the analytical expressions have been derived for cardinal points, pseudo-stigmatic condition and spherical aberration of the system using a modified bell-shaped model. (auth)

26554 QUADRUPOLE SYSTEM FOR ELECTRON-BEAM CURING APPARATUS. Kawakatsu, Hisazo; Kanaya, Koichi (Electrotechnical Lab., Tokyo). Denki Shikensho Iho; 33: 1290-6 (1969).

A quadrupole lens system is proposed for beam irradiation in an electron beam curing apparatus. The electron beam can be focused in a plane and widely spread in another plane using a quadrupole, and also the system is suitable for obtaining a line-focused beam. The calculations show that the line-focused beam of the length 150 cm and the width 1 cm can be obtained by using an electrostatic quadrupole with the relative electrode potential $\phi_1/\Phi = 0.1$, where Φ is the accelerating voltage. Furthermore, the intensity distribution of the beam can be easily corrected by overlapping an octupole field into the quadrupole field. (auth)

26555 AN 8 MeV BETATRON WITH IMPROVED MAGNETIC CIRCUIT. Haltrich, S.; Ianovici, M.; Iliescu, C.; Panaitescu, I.; Mohor, I.; Scarlat, F. (Institut fuer Atomphysik, Bucharest). Kernergie; 13: 16-24(Jan 1970). (In German).

An 8 MeV betatron constructed in the Institute of Atomic Physics, Bucharest, and provided for studying the improved technological and constructive proposals for the design of further betatrons is described. This betatron is being used for investigations of the electron capture process in the betatron and for non-destructive testing of materials. The magnetic circuit is described in detail. The guiding flux and the accelerating flux are separated from each other. The dimensions of the guide field poleface are chosen in such a manner that equilibrium orbit fluctuations arising as a result of magnetic saturation are compensated a great deal into the saturation region. A simple mounting of the magnet is possible; the magnet has 4 yokes, the energizing coils are directly connected to the 380 V mains, and the coils are water-cooled. The electronic circuits, acceleration tube, vacuum system, and injector are described. The radiation obtained corresponds to that from a 30 Ci ^{60}Co source. (auth)

26556 MINIMUM APERTURE ABERRATIONS OF QUADRUPOLE LENS SYSTEMS. Moses, Ronald W. Jr. (Univ. of Wisconsin, Madison). Rev. Sci. Instrum.; 41: 729-40(May 1970).

A focusing system for monochromatic beams of charged particles, with magnetic quadrupole fields having common planes of optical symmetry, is treated theoretically. After specifying certain linear focusing properties for such systems, the calculus of variations is applied to obtain systems with minimum aperture aberrations. First order variational theory is applied to obtain the Euler equations that define extremal systems. This derivation gives four second order, coupled, ordinary differential equations. An iterative technique is presented for solving these Euler equations. Second order variational theory shows that the extrema of the aperture aberrations are local minima with respect to other systems having the same specified linear focusing properties. A digital computer was used to calculate a variety of systems with minimum aperture aberrations. Sample calculations are given for systems with magnifications of −1 and −2. General studies are presented for high magnification systems where the lenses are confined to a region near the object. The best orthomorphic systems have four lenses while the best anamorphotic systems have three. Several methods for regulating the quadrupole gradient strength are studied. It is found that optimum systems have aberration coefficients about one fifth as large as the best systems previously studied. It appears that quadrupoles alone are not as good as round lenses unless the quadrupole bore radius is less than $\frac{1}{14}$ of the length of the shortest quadrupole. (auth)

26557 A LITHIUM ION SOURCE USING THE SURFACE IONIZATION PROCESS. Remy, M.; Haug, R. (Laboratoire de Physique des Milieux Ionises, Nancy). Rev. Sci. Instrum.; 41: 650-2(May 1970).

A capillary ion source using the surface ionization of lithium on rhenium is described. Currents of 400 μA during 300 h, or 100 μA during 1000 h, can be obtained; the life span of the source is only limited by the capacity of the lithium reservoir. (auth)

26558 A POLARIZED ^{59}Co TARGET USING A ^{3}He–^{4}He DILUTION REFRIGERATOR. Fisher, T. R. (Lockheed Research Lab., Palo Alto, Calif.); Healey, D. C.; Parks, D.; Lazarus, S.; McCarthy, J. S.; Whitney, R. Rev. Sci. Instrum.; 41: 684-7 (May 1970).

A ^{3}He−^{4}He dilution refrigerator has been used to cool a 32 g polycrystalline cobalt rod to 0.034 K. The rod is held in a longitudinal magnetic field of 6.5 kOe and has a nuclear polarization of 0.38. The cobalt piece will be used to study the scattering of polarized and unpolarized fast neutrons from polarized ^{59}Co. (auth)

26559 MAGNETIC SOLENOID ELECTRON TRANSPORTER. Kotajima, K.; Beringer, R. (Yale Univ., New Haven). Rev. Sci. Instrum.; 41: 632-5(May 1970).

A magnetic solenoid electron transporter has been constructed to investigate conversion electrons produced in a target by the bombardment of heavy-ion beams. It measures 32 cm in diameter, 124 cm in length, and weighs approximately 290 kg. The target is located at the center of the magnet so that the emitted electrons can be transported toward either end and their energies measured in Si(Li) counters. The energy resolution (for the 624 keV line of ^{137}Cs) and the over-all detection efficiency (for the energy range between 500 and 1200 keV) have been determined to be 6.9 ± 0.2 keV and 6.0 ± 0.4% for a 110 mm^2 counter, and 22.0 ± 0.9 keV and 16.0 ± 1.1% for a 500 mm^2 counter. This distortion of the energy spectrum for the same energy range is less than 7%. (auth)

26560 ON THE ENERGY DETERMINATION OF ACCELERATED ELECTRON BEAMS BY THEIR ATTENUATION IN METAL FOILS. Hollos, G. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 14: 1191-6(1969).

A new method of measuring the energy of accelerated electron beams is proposed, which needs a single measurement of the beam current transmitted through a suitably chosen metal foil. The transmitted-to-incident current ratio allows the computation of the electron energy by using Seliger's normalized transmission curve. (auth)

26561 METHOD AND DEVICE FOR STABILIZATION OF THE FIELD DISTRIBUTION IN DRIFT TUBE LINAC. Knapp, Edward A.; Potter, James M.; Swenson, Donald A. (to U. S. Atomic Energy Commission). U. S. Patent 3,501,734. 17 Mar 1970. Filed 7 Sep 1967.

A method and device for stabilizing the electric field distribution in a drift tube linac are described. An electrically conducting metal coupler mounted to the cavity wall of the accelerator and ranging in shape from a simple post to a T-bar design is positioned so that it is aligned with the center of the drift tube and oriented ±90° from the drift tube stem with adjacent couplers being located on opposite sides of the cavity wall. These couplers are tuned by adjusting their penetration into the cavity. (AEC)

26562 ENERGY CALIBRATION POINTS FOR CLINICAL ELECTRON ACCELERATORS. Anderson, D. W. (Univ. of Oklahoma, Oklahoma City); Swift, S. C. Phys. Med. Biol.; 15: 349-54(Apr 1970).

Bremsstrahlung yield curves were obtained for the photodisintegration reactions ^{16}O(γ,n)^{15}O and ^{31}P(γ,2p)^{29}Al. In both of these curves discontinuities in slope, called breaks, occur which can be used as calibration points for energy. The 17.3 MeV break in the oxygen yield was used to calibrate the energy of the Oklahoma synchrotron. A sharp break suitable for energy calibration occurs in the yield for the phosphorus reaction at 27.6 ± 0.4 MeV. (auth) (UK)

26563 MATRIX METHOD FOR CALCULATION OF ION TRAJECTORIES. ADMITTANCE OF EXTRACTED BEAMS OF

THE I.F.A. CYCLOTRON AT BUDAPEST. Ere, Ya.; Taut, T. (Joint Inst. for Nuclear Research, Dubna, USSR). Rev. Roum. Phys.; 14: 1121-34(1969). (In Russian).

A matrix method is given for the description of ions in various transfer elements (electrostatic lenses, deflector magnets, quadrupole lenses, and elements outside of fields). The matrices are determined for all the elements which can be practically encountered. The programs MITRA and MITRAD for the computer SDS IURN are treated. Starting from the experimental data the admittance of the Bucarest I.F.A. U-120 cyclotron is calculated. The results are analyzed. (tr-auth)

26564 RELATIVISTIC FIELDS DUE TO A PARTICLE IN A GROUNDED CYLINDRICAL BOX. Liboff, Richard L. (Cornell Univ., Ithaca, N. Y.). J. Math. Phys. (N. Y.); 11: 1295-1306 (Apr 1970).

The exact relativistic fields inside a perfectly conducting, closed, grounded cylindrical box of finite length, which are due to a charged particle moving down the axis in vacuum, are obtained. This permits construction of the solution for a line segment propagating down the axis and the return surface current. The fields are shown to be causal so that no field is present before the light front. The technique of solution employs superposition of Lorentz-transformed fields of the positive and negative images. The initial condition that there be no field in the box at time $t = 0$ is satisfied by adding a superposition of the cavity modes to the inhomogeneous solution. The fields and energy in the wake are also found. (auth)

26565 PARTICLE ACCELERATING DEVICE. Urabe, Masahusa (to Tokyo Shibaura Electric Co.). Japanese Patent 1969-23680. 6 Oct 1969. Filed 16 Apr 1966.

A cooling system for the thin metal window of an accelerator tube is described. The system employs gas cooling and may be used in conjunction with the conventional liquid cooling system. This cooling system extends the life of the window. (TSS) (NSA of Japan)

26566 MICROWAVE ELECTRON ACCELERATORS. Nunan, Craig S. (Varian Associates, Palo Alto, Calif.). pp 296-325 of Microwave Power Engineering. Vol. 2. /Okress, Ernest C. (ed.). New York; Academic Press Inc. (1968).

The principles of operation of electron linear accelerators and cyclic electron accelerators using microwave power are reviewed, and techniques for beam handling and use are briefly discussed. Uses of electron accelerators in elementary particle physics, nuclear physics, chemistry, and biology are outlined. Also, medical and industrial applications of electron accelerators are reviewed. (W.H.K.)

26567 RESEARCH ON THE ELECTRON RING ACCELERATOR. Keefe, D. (Univ. of California, Berkeley). Particle Accel.; 1: 1-13(Mar 1970).

The desirable properties for a source of relativistic electrons suitable for ring formation are discussed. The properties of the ring in so-called "compressor" equipment used to shrink the ring are examined and compared with experiment. Problems with betatron resonance effects are treated, including possible strategies for circumventing the problems. Finally there is a brief description of the design of a high energy proton accelerator using current technological methods. (36 references). (auth)

26568 BRIGHT HIGH-GRADIENT 750-keV ION GUN. Sluyters, Th. J. M.; Amari, R.; Kovarik, V.; Lockey, R.; Senator, S. (Brookhaven National Lab., Upton, N. Y.). Particle Accel.; 1: 15-25(Mar 1970).

A one-meter-long, air-insulated, "Pierce" electrostatic accelerator of 750 keV is described in detail. It has an accelerating length of only 17 cm and there is no prefocusing lens. Optically clean pulsed beams of 200 mA have been obtained, using a duoplasmatron with expanded plasma cup. The accelerator has been in continuous operation as preinjector for the Brookhaven Alternating-Gradient Synchrotron since October 1968. (auth)

26569 FAST KICKERS. Forsyth, E. B.; Fruitman, M. (Brookhaven National Lab., Upton, N. Y.). Particle Accel.; 1: 27-39(Mar 1970).

Fast kickers are high speed magnets in which the deflecting force reaches a peak value in less than a few hundred nanoseconds. They were first used as inflectors and have been intensively developed over the last decade as part of the fast extraction system of strong focusing proton synchrotrons. A simple analysis of magnets and pulsing circuits is given, followed by descriptions of the major high power components in modern kickers. In conclusion there is a summary of the characteristics of kickers in service and under development. (17 references). (auth)

26570 SOME LIMITATIONS IN RELATIVISTIC CHARGED PARTICLE BEAMS. Lawson, J. D. (Rutherford High Energy Lab., Chilton, Eng.). Particle Accel.; 1: 41-6(Mar 1970).

Some of the basic characteristics of linear and ring-shaped particle beams are reviewed, with the aid of a simple model and suitable dimensionless parameters. The limiting behavior as the parameter ν/γ approaches unity (where $\nu = Ne^2/m_0c^2$) is discussed in detail. Both static and dynamic systems are considered, and a simple derivation is given of the equilibrium conditions of Budker's self-constricted ring beam. Emphasis is placed on the essential physical characteristics of the beams rather than accurate mathematical description; many of the results represent order of magnitude calculations to show the relation between parameters rather than precise formulae on which to base design. (17 references). (auth)

26571 PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON LOW AND INTERMEDIATE ENERGY ELECTROMAGNETIC INTERACTIONS, DUBNA, USSR, FEBRUARY 7-15, 1967. VOLUME 4. Moscow; Academy of Sciences of the USSR (1967). 344p. (In Russian and English). (CONF-670203-(Vol.4)).

The eleven papers contained in this volume are concerned with accelerators and experimental facilities. The present and future development of electron accelerators are briefly reviewed. Extraction of electron beams from electron synchrotron, measurements of the γ-ray beam intensity, techniques for development and operation of a 600-MeV linear electron accelerators, and beam handling and experimental techniques for modern accelerators are discussed. Data treatment in physical research using electron accelerators at 1 GeV energy, performance of semiconductor detectors and digitized spark chambers in high-energy physics are covered. The data on polarized proton targets and their use in electron accelerators and ultra-low temperature proton and deuteron polarized targets are discussed. (R.V.J.)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

26572 (CEA-N-1117) THERMALIZATION OF 14.7-MeV NEUTRONS PRODUCED BY A LOW ENERGY ACCELERATOR. Mouraille, Herve (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Feb 1970. 11p. (In French). Dep. CFSTI (U. S. Sales Only).

Neutron properties of water, heavy water, graphite and beryllium were compared, and different assemblies realized with these moderators were tested. The order of magnitude of the flux obtained is given. (France)

26573 (GA-9753) INTEGRAL NEUTRON THERMALIZATION. Annual Summary Report, October 1, 1968–September 30, 1969. Borgonovi, G. M.; Houston, D. H.; Neill, J. M.; Slaggie, E. L. (Gulf General Atomic, Inc., San Diego, Calif.). 30 Oct 1969. Contract AT(04-3)-167. 81p. Dep. CFSTI.

Research progress in integral neutron thermalization studies at Gulf General Atomic from October 1, 1968 through September 30, 1969 is reported. The studies included coherent neutron scattering by beryllium, formulation of a central force model for uranium carbide, coherent scattering by UO_2 and UC, temperature dependence of phonon frequency distributions, crystal binding effects on Doppler broadening of neutron absorption resonances, and other miscellaneous activities. (J.W.R.)

26574 (NP-18161) REPORT OF THE FIFTH FOUR-CENTRE MEETING, MOSCOW, 17–21 NOVEMBER 1969. Lorenz, A. (International Nuclear Data Committee). Dec 1969. 26p. (INDC(NDU)-16/N). Dep. CFSTI (U. S. Sales Only).

The fifth of a series of nuclear data Four-Center meetings was held in Moscow, November, 1969. These meetings are for the purpose of coordinating the international effort in the collection, compilation, and dissemination of neutron data information. Highlights of the meeting and the reports are summarized. (J.F.P.)

26575 (TID-25310) NEUTRON TRANSPORT THEORY WITH A COMPLETELY DEGENERATE ENERGY TRANSFER KERNEL. Watts, James Fred (Virginia Polytechnic Inst., Blacksburg). May 1968. 121p. Dep. CFSTI.

Thesis.

An analytic solution of the time-dependent neutron transport equation in slab geometry is found for a completely degenerate energy transfer kernel and a 1/v total cross section. The time dependence is removed from the transport equation by a Laplace transformation and the solution of the homogeneous form of the transformed equation is expanded using the singular eigenfunction expansion method of Case. A superposition of the elementary solutions of the homogeneous transformed equation are used to construct a solution of the inhomogeneous equation with the expansion coefficients determined by the boundary conditions. The time dependence is recovered by the inverse Laplace transform where the path of integration is deformed to the left as far as possible. To demonstrate the method of solution, three problems are outlined: an albedo problem, a two adjacent half-space problem, and an initial value problem. An exact eigenvalue condition is derived in the solution of the initial value problem, and the eigenvalues are calculated. (auth)

26576 ANALYTIC MULTIGROUP THEORY. Egan, Maurice Ralph. Seattle; Univ. of Washington (1969). 223p.

Thesis.

A new analytical method is developed for solving problems in neutron multigroup theory. The method is based on principles of linear operator theory applied to a vector space, one of whose coordinates is discrete. An important property of the method is that it produces solutions, analytic in all continuous coordinates and exact to within the starting approximation, to multigroup problems previously solved only by numerical discrete-ordinate approximations. An additional property of the method is the systematic determination of the conditions under which mathematical separation of coordinates occurs; these conditions are determined from commutation relations between operators describing the physical system. Evidence from simple systems studied indicates that the analytic method provides time-dependent solutions to the multigroup P-1 approximation in computing times comparable to time-independent discrete-ordinate multigroup diffusion approximations. In cases where there are large differences in the energy-dependent transport mean-free-paths, however, numerical difficulties arise which are directly associated with large, purely imaginary components of the complex buckling spectrum. Although these difficulties are numerical in origin and do not represent theoretical defects, nonetheless they presently constitute a limitation in the numerical evaluation of some analytic solutions. (Disser. Abstr.)

26577 COMMENT ON THE INTENSITY OF THE SINGLE SPIN-WAVE NEUTRON CROSS SECTION. Lovesey, S. W. Phys. Lett.; 31A: 53-4(26 Jan 1970).

It is pointed out that the result due to Marshall and Murray (J. Phys. (C), 2: 539(1969)) that the intensity of the single spin-wave cross section is proportional to the average moment per ion for long-wavelength spin waves is independent of the details of their calculation. (auth)

26578 CALCULATION OF FAST NEUTRON SPECTRUM IN A HOMOGENEOUS MEDIUM BY DIRECT OPERATIONAL METHOD. Yamamura, Yasunori; Sekiya, Tamotsu (Osaka Univ.). J. Nucl. Sci. Technol. (Tokyo); 7: 19-25(Jan 1970).

A new formalism based on the direct operational method has been developed for numerically calculating the fast neutron spectrum in an infinite homogeneous medium. By this method the fine structures of nuclear data such as the anisotropy of scattering cross sections in the high energy region can be easily taken into account. Application of this method to light water system has yielded the conclusion that: the effect of anisotropic scattering in the center-of-mass system becomes significant near the source energy and near scattering resonance peaks, the errors introduced by the G.G.-approximation are also significant under similar circumstances, and the contribution from inelastic scattering is negligible (>0.2%) in the case of fission neutron source in light water system. (auth)

26579 A SIMPLE FORMULA TO THE CALCULATION OF THE FAST NEUTRON FLUX IN THE VICINITY OF THE NEUTRON GENERATOR TARGET. Janczyszyn, J.; Loska, L. (Inst. of Nuclear Techniques, Krakow). Radiochem. Radioanal. Lett.; 3: 343-8(24 Apr 1970).

An approximate formula has been derived and checked by comparison with the exact relation given by Op de Beeck. In the vicinity of the target utilized for experiments the discrepancies between the two formulae do not exceed 0.1%. (auth)

26580 RELATION BETWEEN THE PAULI- AND LANDAU-SUSCEPTIBILITY AND THE NEUTRON SCATTERING CROSS SECTION. Schneider, T. (Swiss Federal Inst. for Reactor Research, Wuerenlingen). Solid State Commun.; 8: 279-81 (15 Feb 1970).

The one-electron scattering cross section of thermal neutrons is related to the wave vector and frequency dependent Pauli- and Landau-susceptibilities of Bloch electrons. (auth) (UK)

26581 NEUTRON SCATTERING IN A LEIBFRIED-BRENIG SPECTRUM SPACE LATTICE. Weil, Juergen W. (Univ., Innsbruck). Z. Phys.; 233: 178-80(1970).

The classical high-temperature limit of the pair self-correlation function for a system of harmonic oscillators as introduced by Sunakawa et al. is applied to a lattice whose vibrational spectrum is described by a Leibfried–Brenig approximation. The resulting neutron scattering cross section is discussed qualitatively; it is shown that the principle of detailed balance is fulfilled. (auth)

Nuclear Properties and Reactions, A≤ 5

Refer also to abstract 26641.

26582 (NP-tr-1872) NUCLEAR PHYSICS RESEARCH IN THE USSR (COLLECTED ABSTRACTS). NO. 7. Translation of Yaderno-Fizicheskie Issledovaniya v SSSR (Sbornik Annotatsii), Atomizdat, [Moscow], 1969. 65p. (INDC(CCP)-7/U). Dep. CFSTI (U. S. Sales Only).

A collection of abstracts on nuclear physics research at eight institutes in the USSR is presented. (J.F.P.)

26583 DOPPLER SHIFT MEASUREMENTS OF NUCLEAR LIFETIMES. MacDonald, Jack R. (Bell Telephone Labs., Inc., Murray Hill, N. J.). Science; 167: 1339-47(6 Mar 1970).

The utilization of the Doppler shift in the measurement of nuclear lifetimes is discussed. The mechanics of the experimental techniques — recoil-distance technique, attenuation method, centroid shift analysis, and line shape analysis — are emphasized. (L.W.A.)

26584 PART I. SUM RULES FOR THE d(γ,n)p PROCESS EMPLOYING REALISTIC POTENTIALS. PART II. APPLICATIONS OF THE INTERMEDIATE-COUPLING UNIFIED NUCLEAR MODEL TO ODD-MASS IODINE AND LANTHANUM ISOTOPES. Lucas, Jerome George. Buffalo; State Univ. of New York (1969). 161p.

Thesis.

In the past few years considerable progress has been made in the study of the two-nucleon interaction by using semiphenomenological potential models. Two most successful and most widely used potentials are those suggested by the Yale group headed by Breit and by Hamada and Johnston. These potentials are tested by studying the sum rules for the photodisintegration of the deuteron. The advantage of this approach is that one need only know the ground state of the nucleus under investigation. The integrated cross section, bremsstrahlung-weighted cross section as well as the electric polarizability of the deuteron are calculated. The results are compared with deuteron photodisintegration experiments, by numerically integrating the total cross section curve vs. the energy of the incident γ ray (W) for the three moments weighting W^0, W^{-1} and W^{-2}. The results indicate insensitivity to the details of the Yale and Hamada-Johnston potentials. A study of the sum rules for photodisintegration of the deuteron may not provide any important information which may be useful in distinguishing between the phenomenological nucleon-nucleon potentials. (Disser. Abstr.)

26585 SHORT-RANGE CORRELATIONS IN ^{4}He FROM ELASTIC ELECTRON SCATTERING. Quarati, P.; Watt, A. (Univ. of Glasgow). Lett. Nuovo Cim.; 2: 873-6(21 Dec 1969).

The elastic form factor for ^{4}He is calculated in the harmonic-oscillator shell model using several truncations and taking into account all orders of short-range correlations. The results indicate that higher order terms are appreciable. (J.W.R.)

26586 ^{3}He(n,p)T CROSS SECTION FROM 0.3 TO 1.16 MeV. Costello, D. G.; Friesenhahn, S. J.; Lopez, W. M. (Gulf General Atomic Inc., San Diego, Calif.). Nucl. Sci. Eng.; 39: 409-10 (Mar 1970).

The cross section and pulse-height spectra for the ^{3}He(r,p) reaction was measured at 0.3 to 1.16 MeV using proportional counters. The results are compared with previous direct and indirect measurements. (J.W.R.)

26587 OPTICAL-MODEL ANALYSIS OF THE SCATTERING OF PROTONS FROM ^{4}He AT 31, 40, 46, AND 55 MeV. Thompson, G. E. (Univ. of California, Los Angeles); Epstein, M. B.; Sawada, Tatsuro. Nucl. Phys., A142: 571-6(1970).

Optical-model analyses of the p-^{4}He reaction were carried out at 31, 40, 46, and 55 MeV. Experimental differential cross section, polarization and total reaction cross-section data were fit simultaneously at each energy. An extensive search was made for an optimum set of optical-model parameters based on fits to the experimental data and consistency at the four energies. Two sets of optimum parameters are given and both exhibit unusually large values of r_1, the surface absorption radius. To compare with a phase-shift analysis carried out below 31 MeV, the complex phase shifts corresponding to the optimum parameter sets are also given. (auth)

Nuclear Properties and Reactions, $6 \leq A \leq 19$

Refer also to abstracts 26582, 26583, 26671, 26678, and 26684.

26588 (CONF-680461-9) DETERMINATION OF THE AVERAGE LIFETIME OF THE 5.105-MeV (2^-) LEVELS IN ^{14}N WITH THE HELP OF THE RECOIL METHOD. Meyer, Gustav (Hamburg Univ. (West Germany)). 1968. 44p. (In German). Dep.

From Professional Commission on Nuclear Physics, Bad Neuenahr, Germany.

The recoil method was used to measure the lifetime of the 5.1 Mev (2^-) state in ^{14}N. The adaptation of the method to the experimental conditions was necessary; this consisted principally of the development of a FORTRAN program for the evaluation of the Doppler spectrum at small recoil energies. The effect of the population of the level to be measured on higher lying levels was formally determined. The following value was obtained after evaluation of 15 spectra at five different mark sites with the computer program and after correction for various perturbation effects for the lifetime of the 5.1 Mev (2^-) level: τ_m = (10.0± [illegible]) psec. With the known branching and mixing ratios the following results were obtained: B(E1, 5.1 → 0.0) = $0.31^{10^{-6}}$ e^2fm^2, $|M|^2$ = 0.83 10^{-6} W.E.; B(M2, 5.1 → 0.0) = 0.0.41 μ^2fm^2, $|M|^2$ = 0.45 10^{-2} W.E.; B(E3, 5.1 → 0.0) = 24.6 e^2fm^6, $|M|^2$ = 2.10 W.E.; B(M2, 5.1 → 2.31) = 13.1 μ^2fm^2, $|M|^2$ = 1.36 W.E. The results confirm the measurements of Allen which were also made by the recoil method, but contradict the values of Bishop obtained by means of inelastic electron scattering. An unusually strong delay of the E1 transition resulted from the above results, which is forbidden in the neglect of T = 1−mixed isospin. This is valid only in the long-wave approximation. The calculation of the E1 component in the second approximation leads to a too high ($p_{1/2}d_{5/2}$, T = 0) component in the wave function of the 5.1 Mev level. This indicates that the corresponding T = 1 configuration still contributes to the E1 transition. With an additional ($p_{1/2}d_{5/2}$, T = 1) admixture the M2 ground state transition was evident. The isospin−allowed M2−transition to the first excited level deviates by a factor of 4.5 from the experimental value. This discrepancy can be sharply limited when one considers configurations which arise by accentuation of a nucleon of the $1p_{1/2}$ shell in to sd shell. The E3 transition was comprehensible with an effective charge of ϵ = 0.17. (tr-auth)

26589 SCATTERING OF 100-MeV PROTONS BY ^{11}B AND ^{16}O. Houdayer, A. J.; Li, T. Y.; Mark, S. K. (McGill Univ., Montreal). Can. J. Phys.; 48: 765-74(15 Mar 1970).

The scattering of 100-MeV protons from ^{11}B and ^{16}O was studied. An optical-model analysis of the elastic scattering on these nuclei was performed and a consistent set of optical potential parameters which gave a good fit to the experimental results was obtained. In the inelastic scattering on ^{11}B, it was found that the first excited states were weakly excited whereas the second excited state was fairly strongly excited. The results were explained in terms of the unified model. (auth) (Canada)

26590 STUDY OF THE 1459-keV LEVEL IN ^{19}F BY THE ^{19}F(p,p′γ)^{19}F REACTION. Lam, S. T.; Litherland, A. E.; Simpson, J. J. (Univ. of Toronto). Can. J. Phys.; 48: 827-33(1 Apr 1970).

The 1459-keV level of ^{19}F was populated by the ^{19}F(p,p′γ)^{19}F reaction at a proton energy of 2.78 MeV. The E2/M1 mixing ratio for the 1459 → 110 keV transition was determined to be 0.17 from a combination of the γ-ray angular distribution and linear polarization and the nuclear lifetime. The γ-ray angular distribution was measured with a coaxial Ge(Li) detector and the γ-ray linear polarization with a planar Ge(Li) detector. The corresponding E2 and M1 transition strengths for a lifetime of 0.084 ± 0.020 ps are found to be 14 and 0.10 ± 0.03 W.u. respectively. They are in good agreement with the particle-hole calculations of Benson and Flowers. The branching ratios of the 1459-keV level agree well with those of Poletti et al. The γ-ray transitions from the 1459-keV level provide a good example for demonstrating the usefulness of a single crystal Ge(Li) polarimeter. (auth) (Canada)

26591 INELASTIC SCATTERING OF 100 MeV PROTONS FROM ^{12}C USING A Ge(Li) TOTAL-ABSORPTION PROTON COUNTER. Horowitz, Y. S.; Bell, R. E. (McGill Univ., Montreal). Can. J. Phys.; 48: 210-10(15 Jan 1970).

A cooled Ge(Li) detector was used as a total-absorption proton counter for the energy analysis of 100-MeV protons scattered from a target of natural carbon. An overall energy resolution of 0.5 MeV to 0.6 MeV (FWHM) was achieved. The differential cross sections for the excitation of the 4.43, 7.66, 9.64, 10.8, 11.8, 12.7, 14.1, 15.1, and 16.1 MeV levels were measured at nine angles from 10 to 60° (lab). The angular distributions for the 10.8, 11.8, and 14.1 MeV levels represent the first measured proton-scattering data for these levels in the intermediate energy region (>50 MeV). A qualitative discussion of the excited states is presented, based mainly on the shapes of the angular distributions. At large scattering angles (>30°), the angular distribution for the 0^+ level at 7.66 MeV deviates significantly from 0^+ angular distributions measured in ^{24}Mg and ^{28}Si, suggesting different mechanisms of excitation of 0^+ states in the p and s-d shells. (auth) (Canada)

26592 DISTORTED WAVE ANALYSIS OF DEUTERON KNOCK-OUT FROM ^{6}Li. Jain, A. K. (Bhabha Atomic Research Centre, Bombay); Sarma, N.; Banerjee, B. Nucl. Phys.; A142: 330-44(1970).

The ^{6}Li(p,pd)^{4}He reaction was analyzed using the cluster model for ^{6}Li. The antisymmetrization of the target wave function and the distortion of the incident and outgoing waves were included. It is shown that the intercluster wave function given by the usual cluster models is inadequate and must be modified to have the correct asymptotic behavior to reproduce the experimental p−d angular correlation. The inclusion of distortions is shown to be essential for obtaining the correct value of the differential cross section. (auth)

26593 BEHAVIOR OF THE CROSS SECTION FOR THE ^{9}Be(p,p)^{9}Be REACTION NEAR THE 2.06 MeV (p,n) THRESHOLD. Cooper, M. D.; Figuera, A. S.; Pfeufer, G.; Randers-Pehrson, G. (Univ. of Maryland, College Park). Nucl. Phys.; A142: 445-8 (1970).

An attempt was made to verify the reported existence of anomalies in elastic scattering of protons off ^{9}Be near the (p,n) threshold at 2.06 MeV. No such anomalies could be observed. (auth)

26594 GAMMA RAY DECAY IN ^{19}F FROM ALPHA PARTICLE CAPTURE IN ^{15}N. Tolbert, Donald Dean. Lawrence, Kan.; Univ. of Kansas (1969). 83p.

Thesis.

A study of the gamma ray decay of the compound levels at 5339, 5474, and 5498 keV in ^{19}F was made with the ^{15}N(α,γ)^{19}F reaction. These levels occur at bombarding energies E_{α} = 1681, 1852, and 1883 keV, respectively. Unambiguous $^{7}/_{2}$ and $^{9}/_{2}$ spin assignments to the levels at 5474 and 2797 keV, respectively, and tentative $^{1}/_{2}$ spin assignment to the level at 6339 keV were made. Lifetime measurements were carried out on many levels in ^{19}F with the Doppler shift attenuation method. The lifetimes of the 1460- and 2797-keV levels were found to be 102 ± 35 and 246 ± 44 fs, respectively. The lifetime of the 2797-keV level establishes a positive parity for this level and for the 5474-keV level. Comparison is made between these results and the predictions of current model calculations pertaining to ^{19}F. (Diss. Abstr. Int., B)

26595 CHEMICAL CONSERVATION OF THE ALIGNMENT OF EXCITED NUCLEI RECOILING INTO GASES. Bleck, J.; Haag, D. W.; Ribbe, W. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Z. Phys.; 233: 65-73(1970).

Within a gaseous target of a mixture of SF_6 and CH_4 at a total pressure of 1 atm the orientation of excited ^{19}F nuclei following the reaction ^{19}F(α,α') is studied in terms of the anisotropy of the delayed 197 keV-γ-radiation. By observing the nuclear Larmor precession differentially in time, this anisotropy is found to be constant in time from 50 to 500 nsec after excitation, and to increase from zero to 60% of the anisotropy observed in a solid CaF_2 target, if the relative CH_4 concentration in the target gas of constant total pressure is varied from 0 to 90%. The attenuation of the anisotropy as compared to the value in CaF_2 is explained by a strong perturbation of the nuclear alignment by statistical changes of the atomic fields at the end of the recoil stopping process. The observed partial conservation is interpreted as the contribution of those recoils which have become part of the stable diamagnetic HF molecules before being disoriented. A qualitative discussion shows that the nuclear alignment survives the recoil stopping process down to residual energies of less than a few eV. (auth)

Nuclear Properties and Reactions, $20 \leq A \leq 89$

Refer also to abstracts 25076, 25077, 26558, 26582, 26583, 26627, and 26671.

26596 (BARC-401) PROGRESS REPORT ON NUCLEAR DATA ACTIVITIES IN INDIA. [PART] V. Balakrishnan, M. (comp.) (Bhabha Atomic Research Centre, Bombay (India)). 1969. 39p. Dep. CFSTI (U. S. Sales Only).

ANTIMONY-123—energy level at 160 keV, half-life for
ARGON-38—energy level at 3.77 MeV, half-life for, (E)
ARSENIC-75—energy levels at 199 and 265 keV, half-lives for, (E)
CADMIUM-111—energy level at 342 keV, lifetime for, (E)
CHLORINE-37—energy level at 3.105 MeV, half-life for, (E)
IRIDIUM-193—energy-level transitions in, angular correlation coefficients for, (E)
IRON-59—beta decay of, Fermi matrix elements for, (E)
MERCURY-199—energy level at 198 keV, half-life for, (E)
MOLYBDENUM-95—neutron capture by, $\gamma-\gamma$ angular correlation coefficients for, (E)
MOLYBDENUM-96—energy level at 1.61 MeV from molybdenum-95 neutron capture, spin-parity assignment for, (E)
NEUTRONS, FAST—reactions (n,α), (n,2n), and (n,p) with A = 28 to 165 nuclei at 14.2 and 14.4 MeV, cross sections for, (E)
NEUTRONS, THERMAL—capture by xenon and krypton isotopes, cross sections for, (E)
OSMIUM-186—energy level at 137 keV, half-life for, (E)
POTASSIUM-41—energy level at 1.29 MeV, half-life for, (E)
PROMETHIUM-147—energy levels at 91 and 531 keV, half-lives for, (E)
SAMARIUM-152—energy-level transitions in, conversion electron particle parameters for, (E)
STRONTIUM-88—energy level at 2.734 MeV, half-life for, (E)
TELLURIUM-125—energy levels at 322 and 462 keV, g-factors for, (E)
XENON-131—energy level at 364 keV, half-life for, (E)
—energy-level transitions in, angular correlation coefficients for, (E)
YTTRIUM-89—neutron capture by, $\gamma-\gamma$ angular correlation coefficients for, (E)
YTTRIUM-90—energy level at 0.776 MeV from yttrium-89 neutron capture, spin-parity assignment for, (E)
ZIRCONIUM-91—energy level at 1.208 MeV, half-life for, (E)
(J.W.R.)

26597 (COO-1167-9) NUCLEAR CHEMISTRY RESEARCH. Technical Progress Report, December 15, 1968–December 15, 1969. Sugarman, Nathan; Turkevich, Anthony (Chicago Univ., Ill. Enrico Fermi Inst.). 15 Dec 1969. Contract AT(11-1)-1167. 15p. Dep. CFSTI.

Progress in radiochemical research at the Enrico Fermi Institute of the University of Chicago during the period Dec. 15. 1968 to Dec. 15, 1969 is described. (J.W.R.)

26598 (INP-688) STRUCTURE OF THE LOW LYING LEVELS OF THE ^{33}S NUCLEUS INVESTIGATED BY THE ^{32}S(d,p) REACTION. Bobrowska, A.; Chyla, K.; Strzalkowski, A.; Tomza, U.; Wiktor, S. (Institute of Nuclear Physics, Krakow (Poland)). Nov 1969. 17p. Dep. CFSTI (U. S. Sales Only).

An investigation of the ^{32}S(d,p)^{33}S reaction was made at the deuteron bombarding energy of 12.3 MeV. The energy spectra were measured by magnetic analysis and the obtained angular distributions compared with the predictions of DWBA, using the deuteron optical model parameters obtained from the analysis of the elastic scattering of deuterons on ^{32}S nuclei. The absolute values of spectroscopic factors, extracted on this basis, indicate a significant contribution of higher configurations in the ground-state wave function of the ^{32}S nucleus. There are no arguments which permit the identification of the observed states of the ^{33}S nucleus as rotational states. (auth)

26599 (LA-4312) ATLAS OF GAMMA-RAY SPECTRA. Balagna, J. P.; Helmick, S. B. (Los Alamos Scientific Lab., N. Mex.). 31 Oct 1969. Contract W-7405-eng-36. 94p. Dep. CFSTI.

Gamma-ray spectra produced with a germanium detector are shown. The radioactive species used are those produced by thermal-neutron activation of 70 chemical elements. (auth)

26600 (ORO-3820-3) ON-LINE ALPHA AND PROTON DECAY SPECTROMETRY. Annual Progress Report, 1969. Macfarlane, Ronald D.; Torgerson, David F. (Texas Agricultural and Mechanical Univ., College Station). 15 Jan 1970. Contract AT-(40-1)-3820. 20p. Dep. CFSTI.

The progress in nuclear research by the Texas A & M Dept. of Chemistry during 1969 is summarized. The studies included systems development, beta-delayed alpha and proton decay, alpha decay near the N = 126 closed shell, heavy-ion reactions near the N = 126 closed shell, alpha decay of thermal neutron capture states, and a search for a heavy alpha-emitting component of cosmic rays. (J.W.R.)

26601 (RPI-3948-2) DECAY PROPERTIES OF NEUTRON EXCESS ISOTOPES. Technical Progress Report, January 1–December 31, 1969. Preiss, I. L.; Clark, H. M. (Rensselaer Polytechnic Inst., Troy, N. Y.). Jan 1970. Contract AT(30-1)-3948. 9p. Dep. CFSTI.

Research on the decay properties of neutron excess isotopes at Rensselaer Polytechnic Institute during 1969 is described. The studies covered photonuclear reactions of ^{51}V, decays of samarium isotopes, photonuclear reactions of lutetium, and several other projects on neutron-deficient nuclei. (J.W.R.)

26602 LEVEL STRUCTURE OF ^{88}Rb. Lycklama, H.; Kennett, T. J. (McMaster Univ., Hamilton, Ont.). Can. J. Phys.; 48: 753-8(15 Mar 1970).

The beta decay of 2.8 h ^{88}Kr was investigated using a high-resolution and good efficiency 40 cm^{3} coaxial Ge(Li) counter. A total of 40 gamma rays was detected and determined to belong to the beta decay of ^{88}Kr. All but one of these were placed in a consistent decay scheme. As a result it was possible to give a plausible interpretation to the level structure of ^{88}Rb. (auth) (Canada)

26603 LIFETIME OF THE 77 keV LEVEL IN ^{32}P. Boulter, J. F.; Prestwich, W. V. (McMaster Univ., Hamilton, Ont.). Can. J. Phys.; 48: 868-72(1 Apr 1970).

A delayed coincidence measurement of the half-life of the 77-keV level in ^{32}P populated by the ^{31}P(n,γ)^{32}P reaction was performed. The results obtained using slope, third moment, and two centroid shift analysis procedures are presented, and the mean value of 10 runs performed under different experimental conditions is $T_{1/2} = 253 \pm 25$ ps. (auth) (Canada)

26604 STRENGTH OF ANALOG E2 TRANSITIONS IN ^{30}Si AND ^{30}P. Bizzeti, P. G. (Univ., Florence. Istituto Nazionale di Fisica Nucleare, Florence); Bizzeti-Sona, A. M.; Cambi, A.; Mando, M.; Maurenzig, P. R.; Signorini, C. Lett. Nuovo Cim.; 2: 775-9(1 Dec 1969).

Lifetimes for the 2^+, 2.938-MeV state in ^{30}P and the 2.235-MeV state in ^{30}Si were measured using the Doppler shift attenuation method. The ^{29}Si(p,γ) reaction was used to excite the ^{30}P level and the ^{30}Si(p,p′γ) reaction to excite the ^{30}Si level. The strength functions for the E2 transitions from the levels studied were determined and compared with predictions made on the basis of the Warburton rule. (J.W.R.)

26605 DIPOLE GIANT RESONANCE IN ^{47}Sc AND ^{45}Sc. Vershinin, G. A.; Gamalya, I. A.; Cherdantsev, P. A. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 12, 123-4(1969). (In Russian).

The dipole states of ^{47}Sc and ^{45}Sc were calculated using the same constants of the two-particle interactions as used by G. A. Vershinin et al. (Izv. vuz. SSSR, Physics, 12: 102, 1968). In a quasidiagonal approximation the diagonalization of the energy matrix resulted in diagonalization of 9-dimensional and 15-dimensional matrices for ^{47}Sc and ^{45}Sc, respectively. The results of the calculation of ^{47}Sc dipole photospallation and ^{45}Sc neutron spallation $d_{3/2}\,f_{7/2}$ transition are presented graphically. The width for deuterons and α particles of ^{47}Sc are tabulated. (R.V.J.)

26606 MEASUREMENT OF THE REORIENTATION EFFECT IN ^{24}Mg. Haeusser, O. (Atomic Energy of Canada Ltd., Chalk River, Ont.); Hooton, B. W.; Pelte, D.; Alexander, T. K.; Evans, H. C. Can. J. Phys.; 48: 35-45(1 Jan 1970). (AECL-3483).

The reorientation effect in Coulomb excitation with 62-MeV ^{35}Cl projectiles was used to measure the static quadrupole moment of the first excited state in ^{24}Mg. From a comparison of the inelastic scattering cross sections at CM scattering of 123.1 and 72.8°, a static quadrupole moment of $Q = -0.243 \pm 0.035$ b was deduced. The E2 matrix element connecting the ground state and first excited state was also measured and corresponds to 20.3 ± 1.4 W.u. for the $2^+ \rightarrow 0^+$ transition. The results are compared with predictions of the rotational model. (auth) (CANADA)

26607 EVIDENCE FOR AN INTERMEDIATE MECHANISM IN INTERACTIONS BETWEEN COMPLEX NUCLEI. Gridnev, G. F.; Volkov, V. V.; Wilczynski, J. (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Phys.; A142: 385-91(1970).

The energy spectra of the pickup (^{16}O,F), (^{16}O,Ne) and (^{16}O,Na) reaction products on ^{27}Al, ^{51}V and ^{93}Nb target nuclei were measured for several angles. Characteristic maxima in the spectra, placed much lower in energy than the products of the direct transfer reactions were observed. The appearance of these maxima is tentatively interpreted as resulting from an intermediate reaction mechanism, which should play an important role in a defined region of the angular momentum values. (auth)

26608 LIFETIMES OF EXCITED STATES IN ^{20}F. Holtebekk, T.; Stroemme, R.; Tryti, S. (Univ. of Oslo). Nucl. Phys.; A142: 251-62(1970).

The lifetimes of some levels in ^{20}F were measured by the Doppler-shift attenuation method in the ^{19}F(d,pγ)^{20}F reaction. The energy of γ-rays in coincidence with protons of selected energy is determined with a Ge(Li) spectrometer. Two targets are utilized, and γ-rays emitted in forward and backward directions relative to the motion of the recoiling nucleus are recorded simultaneously in the same spectrometer to eliminate drift or instability effects. From the observed lifetimes the multipole order and the maximum admixture of higher order γ-radiation are determined. The values are compared with those deduced from p-γ angular correlation measurements. In several cases this leads to definite assignments or strongly favored assumptions for the spin values. (auth)

26609 DEUTERON SPIN FLIP IN INELASTIC SCATTERING. Hippelein, H. H.; Jahr, R.; Pfleger, J. A. H.; Rott, F.; Vieth, H. M. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Nucl. Phys.; A142: 369-84(1970).

The angular correlations of inelastically scattered deuterons with gamma rays subsequently emitted perpendicular to the reaction plane were measured. The lowest 2^+ levels of the even nuclei ^{24,26}Mg, ^{32}S, ^{48,50}Ti and ^{58,60}Ni were excited. The fraction of scattered deuterons undergoing a change of the magnetic quantum number by one unit ("half" spin flip) was deduced from the data. The results show that the angular distributions of half-spin-flip probability are very similar in all measured nuclei. They vary from 0% at forward scattering angles to 30% at backward angles. Preliminary DWBA calculations suggest that the main part of half spin flip is caused by spin-orbit coupling in the optical channels. (auth)

26610 PRE-EQUILIBRIUM STATISTICAL MODEL: ANALYSES OF EXCITATION FUNCTIONS. Blann, M.; Lanzafame, F. M. (Univ. of Rochester, N. Y.). Nucl. Phys., A142: 559-70(1970).

Griffin's pre-equilibrium decay model is used, with minor modifications in its derivation, to analyze a variety of excitation functions. The calculated particle spectra are taken to be a sum of pre-equilibrium and equilibrium components, the admixture of the two being determined from comparisons with experimental excitation functions. Additionally, the sensitivity of calculated results to the parameter of the initial number of particles plus holes in the compound state is investigated, and compared for consistency with results from analyses of particle spectra for proton and helium ion induced reactions. The excitation functions analyzed are for the reactions ^{51}V(α,n)^{54}Mn, ^{51}V(α,3n)^{52}Mn, ^{51}V(α,p3n)^{51}Cr, ^{56}Fe(α,3n)^{57}Ni, ^{56}Fe(αp2n)^{57}Co, ^{59}Co(p,3n)^{57}Ni, ^{59}Co(p,p2n)^{57}Co, and ^{197}Au(α,xn)$^{201-x}$Tl(x = 1,4). Excitation energies extend to 100 MeV. Pre-equilibrium fractions of 35% to 65% were required to reproduce the experimental results. (auth)

26611 AN EXPLANATION OF LARGE BACKWARD SCATTERING OF α-PARTICLES ON ^{40}Ca. Schmeing, N. C. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Nucl. Phys., A142: 449-58(1970).

A formula is derived to explain the large backward scattering of α-particles on certain nuclei. It relates the anomaly to α-clustering in the nuclei and becomes the optical-model formula in the limit of uncorrelated nuclei. In calculations for ^{40}Ca the energy dependence is correctly given. (auth)

26612 THE DECAY OF ^{69}As. Muszynski, S.; Mark, S. K. (McGill Univ., Montreal). Nucl. Phys., A142: 459-68(1970).

The β^+ decay of ^{69}As to levels in ^{69}Ge was investigated with the use of Ge(Li), Si(Li) and NaI(Tl) detectors. Six gamma rays at energies of 86.8, 145.8, 232.7, 287.1, 374.1 and 398.1 keV were observed and internal conversion coefficients for the first three gamma rays were measured. On the basis of coincidence measurements, a decay scheme with spin and parity assignments is proposed. The half-life of the 86.8 and 232.7 keV states in ^{69}Ge were measured to be 5.1 ± 0.3 μs and 176 ± 12 ps, respectively. (auth)

26613 SOME MODEL CALCULATIONS OF COULOMB MIXING. Bertsch, George F. (Princeton Univ., N. J.). Nucl. Phys., A142: 499-512(1970).

The nucleus ^{56}Co offers a good case for testing various mechanisms of isospin mixing. The analog state is bound making the mixing calculation easier than for isobaric analog resonances. There is, however, a direct correspondence between the mechanisms in the bound case and in the continuum case. The analog states of this nucleus are at low excitation so there is hope of making detailed model calculations of all the states involved in the mixing. For these calculations the $J = 0^+$ $T = 2$ state of ^{56}Co is considered as a simple 2p-2h shell-model state. Four possibilities are offered for a nearby $T = 1$ 0^+ state. The external mixing mechanism of continuum calculations is a second-order perturbation in this case which gives matrix elements several keV in magnitude. The internal mixing caused by the off-diagonal matrix elements of the Coulomb force has been neglected in continuum calculations, but it is found that in this case it can be comparatively large, of the same order of magnitude as the other mechanisms. There is sufficient disparity between the matrix elements calculated for the different models to distinguish among the models experimentally. For ^{56}Co, experimental data can be interpreted to give a mixing of 33 keV with a nearby state. This is large enough to exclude two of the models. (auth)

26614 j-DEPENDENCE OF l = 1 TRANSITIONS IN THE ^{54}Cr(d,p)^{55}Cr REACTION. Rosalky, D. M.; Baugh, D. J.; Nurzynski, J.; Robson, B. A. (Australian National Univ., Canberra). Nucl. Phys., A142: 469-80(1970).

Differential cross sections for six l = 1 transitions in the reaction ^{54}Cr(d,p)^{55}Cr were measured at a deuteron bombarding energy of 8 MeV. The data were described qualitatively by DWBA calculations employing spin-orbit terms in the deuteron and proton optical-model potentials to reproduce the observed dependence on j. Spin assignments of $3/2$, $1/2$, $3/2$, $1/2$ and $1/2$ were made for the ground, 0.245, 0.573, 1.487 and 2.905 MeV states in ^{55}Cr. The $2p_{3/2}$ and $2p_{1/2}$ spectroscopic factor sums were found to be 0.66 and 0.56 respectively indicating a large admixture of $(2p_{1/2})^2$ configurations in the ground state of ^{54}Cr. (auth)

26615 ISOSPIN MIXING FOR BOUND ANALOG STATES IN ^{56}Co AND ^{58}Co. Dzubay, T. G. (Princeton Univ., N. J.); Sherr, R.; Becchetti, F. D. Jr.; Dehnhard, D. Nucl. Phys., A142: 488-98 (1970).

Transitions to levels in the vicinity of the ground state analogs in ^{56}Co and ^{58}Co were investigated using the Fe(^{3}He,t)Co reactions at 24.6 MeV. Two predominantly L = 0 transitions, 70 keV apart were observed where the analog state in ^{56}Co was expected to occur. Near the expected analog state energy in ^{58}Co two L = 0 transitions spaced at 20 keV were observed. Tentative assignments of 0^+ are made for all four levels. These doublets are discussed in terms of a large isospin impurity of the analog state in a $T_<$ state. The observed cross-section ratios and splittings are used to estimate off-diagonal matrix elements of the charge dependent part of the Hamiltonian of 33 keV for ^{56}Co and 10 keV for ^{58}Co. (auth)

26616 TWO-QUASIPARTICLE STATES OF ^{82}Kr POPULATED IN THE DECAY OF ^{82g}Br. Meredith, G. R.; Meyer, R. A. (Univ. of California, Livermore). Nucl. Phys., A142: 513-24(1970).

Gamma-ray spectroscopic studies of ^{82g}Br were performed. Compton suppression techniques were used to detect low-energy, low-intensity γ-rays. These were used to deduce the two-quasiparticle nature of the levels above the pairing gap. Some evidence for an intrashell collective state above the pairing gap was found. (auth)

26617 MEAN LIVES OF SOME STATES IN ^{33}S. Cummings, J. E.; Donahue, D. J. (Univ. of Arizona, Tucson). Nucl. Phys., A142: 609-18(1970).

The mean lives of the 0.84-, 1.97-, 2.31-, 2.94- and 3.22-MeV levels were studied using the Doppler-shift attenuation method (DSAM). The ^{32}S(d,p)^{33}S reaction was used with deuteron energies ranging from 1.86 to 2.50 MeV to populate the excited levels of ^{33}S. The directions of the recoiling nuclei were determined by detecting γ-rays in coincidence with protons. Mean lives of τ_m = 0.9, 0.15 ± 0.03, 0.14 ± 0.04, > 1.4 and 0.04 ps were found for the levels at E_x = 0.84, 1.97, 2.31, 2.94 and 3.22 MeV, respectively. Where applicable, the results are compared to predictions of the strong-coupling rotational model. (auth)

26618 LIFETIMES IN ^{32}S. Ollerhead, R. W.; Alexander, T. K.; Haeusser, O. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys.; 48: 47-55(1 Jan 1970). (AECL-3485).

Lifetimes were measured for five levels in ^{32}S. The levels were populated by inelastic scattering of protons, and the gamma rays were detected at angles between 0 and 127° using a 40 cm^3 Ge(Li) detector mounted inside a split annular NaI(Tl) crystal. The spectrometer was used simultaneously as both an escape-suppressed and a three-crystal pair spectrometer. Decay schemes and lifetimes were determined using thick targets of PbS, MoS$_2$, and sulfur cooled to 77°K. Lifetime information was obtained both from analysis of the observed gamma-ray line shapes and from analysis of the Doppler shift attenuation in the different target materials. The two methods of analysis agree within the errors. A weak ground-state transition was observed from the J = 3 level at 5.012 MeV, establishing its parity as negative. Analysis of the line shape observed at 0° and the Doppler shift attenuation gave an average lifetime of $7.5 \pm 0.5 \times 10^{-13}$ s. The observed branching ratio (4 ± 0.4% to the ground state) implies an E3 enhancement of 20 ± 2.4 Weisskopf units (W.u.). A similar analysis gave a lifetime of $4.9 \pm 0.9 \times 10^{-13}$ s for the J = 1 level at 4.699 MeV, which implies that the dipole transition to the ground state is highly retarded. Lifetimes were also measured for levels at 3.780 MeV (1.0×10^{-12} s), 4.288 MeV ($7.4 \pm 0.6 \times 10^{-14}$ s), and 5410 MeV ($1.9 \pm 0.2 \times 10^{-13}$ s); the transition strengths are tabulated and discussed. (auth) (Canada)

26619 PRODUCTION OF ^{7}Be, ^{22}Na, ^{24}Na, AND ^{28}Mg BY IRRADIATION OF ^{27}Al WITH 52-MeV DEUTERONS AND 104-MeV ALPHA PARTICLES. Martens, Uta; Schweimer, Georg W. (Kernforschungszentrum, Karlsruhe, Ger.). Z. Phys.; 233: 170-7(1970).

Excitation functions for the production of ^{7}Be, ^{22}Na, ^{24}Na and ^{28}Mg by irradiation of ^{27}Al with deuterons and alpha particles were measured for the energy range available with the Karlsruhe Isochronous Cyclotron. The error in the absolute cross section scale is estimated to be 2.5%. The error in the energy scale is about 1 MeV in the threshold region and 0.5 MeV at the maximum energy. (auth)

26620 ANGULAR DISTRIBUTION OF α PARTICLES FROM THE REACTION ^{64}Zn(n,α_0)^{61}Ni WITH 14.9-MeV NEUTRONS. Schenk, K.; Staudt, G. (Univ., Tuebingen, Ger.). Z. Naturforsch.; 24a: 2019-20(Dec 1969). (In German).

A measurement of the angular distribution of the reaction ^{64}Zn(n,α_0)^{61}Ni was reported. The research installation is described. The energy spectra were measured for 8 different distances (Zn target—detector) between d = 4 mm and d = 28 mm. The angular distribution observed has a definite maximum in the forward direction. The form of the distribution is characteristic for a direct process. A DWBA calculation was made and the results are shown graphically. From the comparison of the measurement and calculation results, it is shown that the measured angular distribution is compatible with the results obtained from the DWBA theory. (J.S.R.)

26621 NEUTRON-INDUCED REACTIONS BETWEEN 14.4 AND 16.7 MeV. Clator, Irvin Garrett. Morgantown, W. Va.; West Virginia Univ. (1969). 109p.

Thesis.

Neutron induced reactions with some medium atomic weight nuclei were studied for incident neutron energy between 14.4 and 16.7 MeV, and the results compared to the statistical model predictions. The reactions studied were: ^{24}Mg(n,p)^{24}Na; ^{52}Cr(n,p)^{52}V; ^{65}Cu(n,p)^{65}Ni; ^{66}Zn(n,p)^{66}Cu; ^{68}Zn(n,p)^{68}Cu; ^{65}Cu(n,α)^{62g}Co; ^{65}Cu(n,2n)^{64}Cu. The method of neutron activation was used. A pneumatic transfer system was used to shuttle the samples between the flux and detectors, and both a NaI(Tl) detector and a Ge(Li) detector were used in the gamma counting. The Zn(n,p) and Cu(n,α) excitation functions are reported for the first time. (Diss. Abstr. Int., B)

26622 ^{3}He-INDUCED NUCLEAR REACTIONS IN COPPER. Golchert, Norbert William. Chicago; Illinois Inst. of Tech. (1969). 166p.

Thesis.

Excitation functions for 22 nuclear reactions induced by helium-3 projectiles on copper were measured. Excitation functions were measured for all radioactive products of half-life greater than ten minutes up to 35 MeV and the long lived products surveyed to 70 MeV. The stacked foil technique was used and the induced activities chemically separated from each foil. The results are discussed in terms of interpreting nuclear reaction mechanisms and by comparison with existing similar reaction data. The measurements indicate that in the 25 to 35 MeV energy region, the (^{3}He,xn) reaction accounts for only 10% of the total cross section. In contrast, (a,xn) cross sections in a similar energy region account for about 90% of the total cross section. The dominant helium-3 induced reaction in this region is the (^{3}He,p2n) reaction which accounts for 65% of the total cross section. The identification of tritium in the foils may imply that part of this reaction is (^{3}He,t). An overall examination of the excitation functions appears to indicate a greater abundance of direct interactions, i.e., pickup, stripping, and exchange reactions, then with alpha particles. Particularly at higher incident energies, a sequential direct interaction-compound nucleus mechanism appears to provide the best description. The reaction is initiated by a fast direct interaction process with the resulting nucleus being left with sufficient energy to evaporate additional particles, usually neutrons. This fast—slow mechanism appears to be a plausible explanation based on the excitation function data. (Diss. Abstr. Int., B)

26623 STUDIES OF HALF LIFE OF LEVELS IN ^{77}As. Azimov, K. Sh.; Begzhanov, R. B.; Teshabaev, K. T. (Inst. of Nuclear Physics, Tashkent). Dokl. Akad. Nauk Uzb. SSR; No. 6, 27-30(1969). (In Russian).

A fast-slow scheme of coincidences and a time-amplitude converter were used for measuring half-lives of excited states of ^{77}As. A stilbene crystal with a photomultiplier was used for detection of β spectra and γ quanta. Tabulated data on γ transition probabilities in ^{75}As and ^{77}As nuclei are presented. (R.V.J.)

26624 THE REACTION ^{27}Al(d,p)^{28}Al IN THE ENERGY RANGE OF THE DEUTERON FROM 2.0 MeV TO 3.0 MeV. Lin, C. S.; Lin, E. K. (Tsing Hua Univ., Taiwan. Academia Sinica, Taiwan). Nuovo Cim.; 66A: 336-42(21 Mar 1970).

The ^{27}Al(d,p)^{28}Al reaction was studied at bombarding energies between 2.0 and 3.0 MeV. Excitation functions in steps of 15 keV at angles of 90 and 150° and angular distributions from 15 to 150° were measured for four proton groups leading to the low-lying levels of ^{28}Al. Two mechanisms of compound nucleus and direct interaction were found to be contemporaneously present in the reaction. The direct effect contribution for the group p_0 corresponding to the ground-state transition was calculated by the DWBA stripping theory. The experimental total cross sections at 2.5 MeV compared to the Hauser—Feshbach calculations are given and discussed. (auth)

26625 MEASUREMENT OF SOME CAPTURE CROSS SECTIONS FOR FAST NEUTRONS. Colditz, J.; Hille, P. Oesterr. Akad. Wiss. Math.-Naturwiss. Kl., Anz.; 105: 236-41(1968). (In German).

At a neutron energy of 2.9 ± 0.2 MeV the following cross sections of (n,γ) reactions were determined: ^{26}Mg = 0.21 ± 0.03, ^{27}Al = 0.30 ± 0.05, ^{37}Cl = 0.59 ± 0.09, ^{51}V = 1.4 ± 0.2, ^{55}Mn = 2.2 ± 0.2, ^{65}Cu = 6.2 ± 0.8, ^{68}Zn (55-min activity) = 2.6 ± 0.4, ^{75}As = 14.0 ± 1.4, ^{115}In (54-min activity) = 68 ± 11, ^{127}I = 42.8 ± 5.0, and ^{138}Ba = 3.0 ± 0.4 mb. All effective cross section determinations were made by the activation method relative to the cross section σ^{115}/n (n,n'γ) $^{115\mathrm{m}}$/n = 360 mb. Various materials were studied for their suitability as deuterium self-targets in the production of fast neutrons. (tr-auth)

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Refer also to abstracts 25257, 25284, 26318, 26573, 26582, 26583, 26596, 26597, 26599–26601, 26607, 26610, and 26625.

26626 (ANL-Trans–808) FINE STRUCTURE OF THE ENERGY DEPENDENCE OF $\bar{\nu}$ FOR ^{233}U AND ^{235}U IN FISSION INDUCED BY NEUTRONS OF LESS THAN 1 MeV ENERGY. Kuzmetsov, V. K.; Smirenkin, G. N. Translated for Argonne National Lab., Ill., from IAEA Conference on Nuclear Data for Reactors, Paris, October 17–21, 1966, Vol. 2. 13p. Dep. CFSTI.

The results of comparative measurements of the average number of secondary neutrons for ^{233}U and ^{235}U in the energy range of fission-inducing neutrons up to 1 MeV are given. The results of the comparative measurements were converted to absolute values on the basis of the relation $\bar{\nu}(E_n) = \bar{\nu}_{th} + a(E_n - \Delta\bar{E}_n)$ where $\bar{\nu}(E_n)$ and $\bar{\nu}_{th}$ are respectively the mean number of secondary neutrons for any primary-neutron energy E_n and for thermal energy, a is a parameter inverse to the mean energy of neutron emission and $\Delta\bar{E}_n$ is the difference between the mean kinetic energy of fragments in the case of fission induced by neutrons of energy E_n and by thermal neutrons. Use of this relation is based on the fact that, within the limits of the neutron energy range studied, a change in the mass yield curve and the energy removed by neutrons and fission gamma rays have no pronounced effect on the redistribution of energy between the collective and internal degrees of freedom of the fissioning nucleus. The feasibility of this indirect method of arriving at absolute figures was corroborated by deriving the absolute values for ^{235}U directly. Possible interpretations of the results obtained are presented. (auth)

26627 (ANL-Trans–811) STUDIES OF THE MECHANISM OF NEUTRON CAPTURE IN THE RESONANCE REGION. Gersch, Hans-Ulrich (Zentralinstitut fuer Kernforschung, Rossendorf Bei Dresden (East Germany)). Translated for Argonne National Lab., Ill., from Sections 3, 3.1, and 3.2, pp 37-58 of report ZFK-136. 31p. Dep. CFSTI.

The study of the mechanism of neutron capture in the resonance region covers experimental methods to determine channel capture, including the anomalous behavior of the intensities of primary gamma transitions and a comparison of the (n,γ) and the (d,p) reaction in the same nuclide. (J.F.P.)

26628 (ANL-Trans–815) A STUDY OF THE LEVEL SCHEME OF ^{178}Hf. Prokof'ev, P. T.; Rezvaya, G. L. Translated for Argonne National Lab., Ill., from Izv. Akad. Nauk SSSR, Ser. Fiz.; 33: 1655-61(1969). 10p. Dep. CFSTI.

The energy level scheme of hafnium-178 was studied using a beta-ray spectrograph. There were 70 transitions identified, 28 for the first time, in the energy region from 770 to 2000 keV. Multipole orders were assigned to certain high-energy gamma transitions and are shown. Also ratios of reduced probabilities and intensities of transitions from levels 22$^+$ and 23$^+$ to the levels of the rotational band of the ground state are given. A level scheme is proposed. The gamma and beta vibration bands and the rotational bands of two-quasiparticle states are discussed. (J.F.P.)

26629 (CEA-N–1268) PROPERTIES OF LEVELS INDUCED BY 0 TO 30 keV NEUTRONS IN STABLE ISOTOPES OF TELLURIUM. Tellier, Henry; Alix, Michel; Dabbs, John (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Feb 1970. 79p. (In French). Dep. CFSTI (U. S. Sales Only).

Total cross section measurements were carried out by the time-of-flight method for the tellurium isotopes. The Saclay linac was used as a neutron pulsed source. Resonance parameters were obtained by a shape analysis. For each isotope the strength function and level density parameter were obtained. (auth)

26630 (CEA-R–3455) STUDY OF ONCE- AND TWICE-FORBIDDEN BETA TRANSITIONS. Hocquenghem, Jean-Claude (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Dec 1969. 108p. (In French). Dep. CFSTI (U. S. Sales Only).

Thesis. Submitted to Univ. of Grenoble, France.

Measurements of β–γ angular correlations and β shape-factors were carried out for the following transitions: the first forbidden β^- transitions of 386 keV of ^{177}Lu and of 352 keV of ^{175}Yb, the twice forbidden β^- transition of 473 keV of ^{94}Nb. For ^{177}Lu and ^{175}Yb, the experimental results were compared with the theoretical predictions of the Nilsson model. For ^{94}Nb, the β transition nuclear matrix elements were extracted from the experimental results. Comparisons were made with the theoretical values calculated by taking for nuclear wave functions those obtained through diagonalization of the residual interaction, assuming that protons and neutrons, outside the ^{90}Zr core, are respectively on the 1g $^9\!/_2$ and 2d $^5\!/_2$ orbits. (auth)

26631 (COO–1716-8) THERMODYNAMIC STUDIES ON HEAVY ELEMENTS AND STUDIES IN NUCLEAR CHEMISTRY. Annual Report, February 1969–January 1970. Cobble, J. W. (ed.) (Purdue Univ., Lafayette, Ind. Dept. of Chemistry). 1 Jan 1970. Contract AT(11-1)-1716. 14p. Dep. CFSTI.

Research progress is reported on: the chemically bound neutron; additional sources for chemically bound neutrons; ternary fission of Th; search for ternary fission in ^{197}Au, ^{209}Bi, and ^{239}Pu induced with ^{4}He ions; range of ^{28}Mg from ternary fission of ^{238}U with 35-MeV protons; heavy-ion ternary fission studies; thermodynamic functions for Pu^{3+}(aq); standard state entropies for the aqueous trivalent lanthanide and yttrium ions; and partial molal heat capacity of UO_2^{2+}(aq). (M.C.G.)

26632 (COO–1746-31) DETERMINATION OF THE E2/M1 MULTIPOLE MIXING RATIOS OF THE GAMMA TRANSITIONS IN ^{110}Cd. Krane, K. S.; Steffen, R. M. (Purdue Univ., Lafayette, Ind. Dept. of Physics). [1969]. Contract AT(11-1)-1746. 32p. Dep. CFSTI.

The multipole character and E2/M1 mixing ratios of all gamma transitions following the decay of $^{110\mathrm{m}}$Ag to ^{110}Cd were determined by measuring the 1–2, 1–3, and 1–4 directional correlations using two 30cc coaxial Ge(Li) detectors in conjunction with a multichannel coincidence gating system. The analysis of the data clearly demonstrated the necessity for careful investigations of the effects of the Compton background on directional correlation measurements using Ge(Li) detectors. The directional correlation functions for mixed gamma-gamma cascades are given in terms of explicitly defined reduced matrix elements and their ratios $\delta(\gamma_n)$. The analysis of the 25 measured directional correlations yielded a consistent set of E2/M1 mixing ratios for all mixed multipole transitions. The E2/M1 amplitude ratios $\delta(\gamma_n) = \langle I_{n+1} \| j_N A_2^E \| I_n \rangle / \langle I_{n+1} \| j_N A_1^M \| I_n \rangle$ for the ^{110}Cd gamma rays are (energies are in keV): $\delta(447) = -0.45 \pm 0.20$, $\delta(620) = -0.80 \pm 0.50$, $\delta(678) = -0.25 \pm 0.20$, $\delta(687) = -1.1^{+0.8}_{-0.4}$, $\delta(707) = -1.0 \pm 0.3$, $\delta(818) = -1.20 \pm 0.15$, $\delta(1384) = -0.37 \pm 0.03$, $\delta(1505) = -0.55 \pm 0.10$. In terms of the multipole moments $\langle I_{n+1} \| \mathcal{M}(\pi L) \| I_n \rangle$ of Bohr and Mottelson the E2/M1 moment ratios $\Delta = \langle I_{n+1} \| \mathcal{M}(E2) \| I_n \rangle / \langle I_{n+1} \| \mathcal{M}(M1) \| I_n \rangle$ in natural units (n = m = c = 1) are: $\Delta(447) = 3.0 \pm 1.3$, $\Delta(620) = -3.8 \pm 2.4$, $\Delta(678) = -1.09 \pm 0.88$, $\Delta(687) = -4.7^{+1.4}_{-1.1}$, $\Delta(707) = -4.2 \pm 1.3$, $\Delta(818) = -4.3 \pm 0.5$, $\Delta(1384) = -0.79 \pm 0.06$, $\Delta(1505) = -1.08 \pm 0.20$. (auth)

26633 (INR–1102) THE QUASIPARTICLE AND COLLECTIVE STATES OF THE ^{165}Er NUCLEUS. Preibisz, Z. (Institute of Nuclear Research, Warsaw (Poland)). 1969. 134p. (In Polish). Dep. CFSTI (U. S. Sales Only).

The β^+ and γ spectra as well as e-γ and γ-γ coincidence spectra accompanying the ^{165}Tm → ^{165}Er decay were investigated. The positron radiation with $E_{max} = 300 \pm 30$ keV and intensity $6.5 \pm 2.0 \times 10^{-5}$ positrons per decay were found. Nine new energetic levels were introduced and a decay scheme proposed. Three new rotational levels were established with band heads $^1\!/_2^+$, 507 keV, $^1\!/_2^+$, 745 keV and $^1\!/_2^-$, 920 keV. The character of the highest excited level in ^{165}Er with energy 1427 keV observed after the capture of an electron by the ^{165}Tm nucleus was discussed. This state is fed by the allowed unhindered beta decay au, log ft = 5.0. A suggestion is made that this excitation has a three-particle character and is due to the break of one neutron pair close to the Fermi surface. The properties of other nonrotational levels were considered in the frame work of a nuclear model which takes into account the interaction of quasiparticles with phonons of collective quadrupole and octupole vibrations. The experimentally established energies of one-quasiparticle states were compared with energies calculated on the basis of the Nilsson plus pairing model. (auth)

26634 (INR–1110) INVESTIGATION OF THE DECAY SCHEME OF ^{125}Xe AND INTERPRETATION OF THE EXPERIMENTAL RESULTS ON THE BASIS OF THE SHELL MODEL INCLUDING PAIRING AND QUADRUPOLE INTERACTIONS. Ludziejewski, J. (Institute of Nuclear Research, Warsaw

(Poland)). 1969. 113p. (In Polish). Dep. CFSTI (U. S. Sales Only).

Study of the decay scheme of ^{125}Xe to ^{125}I was carried out using germanium and silicon detectors as well as NaI/Tl and anthracene crystals. Samples of ^{125}Xe were prepared by irradiating natural Xe in a reactor. Some measurements were done using also mass-separated ^{125}Xe sources. The singles and coincidence γ spectra, the life-time of the first three excited states, the total decay energy of ^{125}Xe, and the gamma-gamma angular correlations were measured. Based on these measurements the decay scheme of ^{125}Xe was proposed, the log ft values of electron capture transitions to the excited states of ^{125}I were determined, and the reduced transition probabilities B M1 and B E2 as well as spins of several excited states of ^{125}I and ^{125}Xe ground state were established. The results concerning the low-energy states of ^{125}I obtained were compared with the prediction of the single particle model as well as with the Kisslinger–Sorensen model. For the M1 and E2 electromagnetic transition ratios there is relatively good agreement of experimental results with theoretical ones calculated on the basis of the Kisslinger and Sorensen model. The excited states scheme of ^{125}I is in disagreement with theoretical predictions. (auth)

26635 (JEN–209-DF/1-61) EXCITED LEVELS OF ^{233}Pa. Vara Cuadrado, J. M. (Junta de Energia Nuclear, Madrid (Spain)). 1969. 88p. (In Spanish). Dep. CFSTI (U. S. Sales Only).

A study of ^{233}Pa excited levels from the alpha decay of ^{237}Np and from beta decay of ^{233}Th was performed. The alpha decay spectrum was measured with a semiconductor spectrometer of 18 keV effective resolution (FWHM). Over 13 new lines were identified. The gamma ray spectra of ^{237}Np and ^{233}Th were obtained with a Ge–Li detector for low- and medium-range energy lines, and with a Si–Li detector for the low energy region. A continuous purification method of ^{237}Np from its comparatively short-lived daughter ^{233}Pa was applied. A high number of new lines were identified in both spectra. The gamma-gamma coincidence spectra were obtained with INa(Tl) detectors. (auth)

26636 (JINR–E4–4908) 1^+ STATES IN DEFORMED NUCLEI. DIPOLE SUM RULE AND STRENGTH FUNCTION FOR M1 TRANSITIONS. Gabrakov, S. I.; Kuliev, A. A.; Pyatov, N. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1970. 14p. Dep. CFSTI (U. S. Sales Only).

The properties of 1^+ excitations and the role of spin-spin interaction in formation of a magnetic dipole resonance in even rare earth nuclei are investigated. It is shown that the spin-spin interaction decreases the average reduced width for M1 transitions for the low-lying 1^+ states and concentrates a large part of M1 strength in the region of energy of 10 to 13 MeV. M1 resonance is formed mainly by transitions between discrete levels belonging to the spherical spin-orbital partners and is considered as a quasi-stationary state in the continuous spectrum. (auth)

26637 (JINR–P7–4932) SPONTANEOUS FISSION OF THE ISOTOPES OF ELEMENTS 103 AND 105. Flerov, G. N.; Oganesyan, Yu. Ts.; Lobanov, Yu. V.; Lazarev, Yu. A.; Tret'yakova, S. P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1970. 9p. (In Russian). Dep. CFSTI.

Production of spontaneously fissionable nuclei in bombarding ^{243}Am with ^{18}O and ^{22}Ne ions (with the energies 95 and 119 MeV, respectively) was investigated. It is shown that for 103 isotopes with the mass numbers 256 and 257 the period of spontaneous fission is more than 10^5 s. In the reaction ^{243}Am + ^{22}Ne an emitter of the spontaneous fission fragments with the half-life of about 2s was observed; its yield corresponds to the cross section 10^{-34} cm^2. Special check experiments as well as the analysis of other possible reactions allow one to assume that the spontaneous fission of element 105 produced in the reaction ^{243}Am(^{22}Ne, xn) $^{265-x}$105 was observed. (auth)

26638 (JINR–P7–5018) SEARCH FOR SPONTANEOUSLY FISSIONABLE ISOMERS WITH NANOSECOND LIFE TIME IN THE REACTIONS WITH HEAVY IONS. Flerov, G. N.; Gangrskii, Yu. P.; Markov, B. N.; Nguyen Kong Khan; Pulatov, D. D.; Shadieva, N. Kh. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1970. 11p. (In Russian). Dep. CFSTI (U. S. Sales Only).

The search for spontaneously fissionable isomers with half-lives in the range 10^{-9} to 10^{-7} s was carried out among the neutron-deficient isotopes beginning from the rare-earth region to Rn nuclei. With that end in view the targets of elements with even Z from Te to Pt were bombarded with ^{11}B and ^{16}O ions. The technique of detecting the fission fragments of the recoil nuclei, decaying in flight, was used. The results of the experiments were negative. Only upper boundaries of the cross sections and the half-lives are presented. Using the same technique the ^{232}Th and ^{238}U targets were bombarded with ^{11}B, ^{12}C, and ^{16}O ions. The experiments proved the existence of the spontaneously fissionable isomers with $T_{1/2} \cong 10^{-9}$ to 10^{-8} s. (auth)

26639 (LA–4063-tr) GAMMA-RAY SPECTRA FOLLOWING THERMAL NEUTRON CAPTURE BY NEODYMIUM ISOTOPES. Groshev, L. V.; Dvoretskii, V. N.; Demidov, A. M.; Rakhimov, A. S. (Akademiya Nauk SSSR, Moscow. Institut Atomnoi Energii). Translated by Helen J. Dahlby (Los Alamos Scientific Lab., N. Mex.), from report IAE–1489. 13p. Dep. CFSTI.

The gamma-ray spectra arising from thermal-neutron capture by samples enriched in the A = 142, 143, 144, 145, and 146 neodymium isotopes were measured with a germanium-detector spectrometer. The spectrum of the natural-isotope mixture was also obtained, both with the germanium detector and magnetic Compton spectrometers. The energies and intensities of the resolved gamma lines in the spectra were determined. From these data, gamma transition schemes for the five neodymium isotopes were set up. First data were obtained on the gamma transitions of odd-A neodymium isotopes after thermal-neutron capture; this information is interesting in that there are one (in ^{143}Nd), three (in ^{145}Nd), and five (in ^{147}Nd) neutrons outside a closed neutron shell. In all the nuclei the relatively intense, high-energy transitions were found to go to the 0.6- to 0.8-MeV energy levels, which are more likely to be $3p_{1/2}$ and $2f^{+}_{1/2}$configurations than single-photon excitations with $3/2^-$ spin–parity. A transition to the $(2f_{1/2})_{1/2^-}$ ^{145}Nd level was not observed. (auth)

26640 (MIT-2098-601) NUCLEAR MOMENT MEASUREMENTS USING HEAVY ION RECOIL TECHNIQUES. Grodzins, L. (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science). 10 Dec 1969. Contract AT(30-1)-2098. 26p. (CONF-690707–3). Dep. CFSTI.

From International Conference on Nuclear Reactions Induced by Heavy Ions, Heidelberg, Germany.

The uses of heavy ions to measure magnetic moments of nuclear excited states are discussed. Results and charts of the measurement of gyromagnetic ratios of the first 2+ states of even-even nuclei are presented. Brief descriptions of IMPAC, a technique for the study of the perturbation of angular correlations following the implantation of nuclei into ferromagnetic environments, and of hyperfine interactions on ions recoiling in a vacuum are given. Early attempts to measure quadrupole interactions of moderately short-lived nuclear states by spectroscopic techniques involving ion implantation into crystals are described. (35 references) (L.W.A.)

26641 (ORO–3921-3) NUCLEAR SPECTROSCOPY. Progress Report, January 1–December 31, 1969. Sugihara, T. T.; Watson, R. L. (Texas Agricultural and Mechanical Univ., College Station. Cyclotron Inst.). Contract AT(40-1)-3921. 52p. Dep. CFSTI.

ALPHA PARTICLES—reactions (α, 4n) with gold-197 at 50 MeV, conversion electron spectra from, (E)
  —collisions with iron and tin atoms at 30 to 80 MeV, excitation functions for production of K x-rays in, (E)
  —collisions with lead atoms at 50 MeV, L x-ray fluorescence spectra from, (E)
BETA SPECTROMETERS—development of magnetic, for in-beam conversion electron studies
COMPUTER PROGRAMS—for analyzing multiplets in spectra measured by lithium-drifted germanium detectors
GADOLINIUM-152—energy levels from terbium-152 decay, (E)
GAMMA SPECTROSCOPY—computer program for analyzing multiplets in, of lithium-drifted germanium detectors
GOLD-197—alpha reactions (α, 4n) at 50 MeV, conversion electron spectra from, (E)
HAFNIUM-174—energy levels from tantalum-174 decay, (E)
IRON—alpha collisions at 30 to 80 MeV, excitation function for production of K x-rays in, (E)
LEAD—alpha collisions at 50 MeV, L x-ray florescence spectra from, (E)
TANTALUM-174—beta decay of, γ spectra from, (E)
TERBIUM-150—decay of ground-state and isomeric, γ energies and intensities from, (E)
TERBIUM-152—beta and electron-capture decay of isomeric, γ singles and coincidence spectra and conversion electron spectra from, (E)
TIN—alpha collisions at 30 to 80 MeV, excitation function for production of K x-rays in, (E) (J.W.R.)

26642 (UUIP–612) INTERNAL CONVERSION STUDIES OF TRANSITIONS POPULATING AND DEPOPULATING THE 161-keV LEVEL IN ^{133}Cs. Toernkvist, S.; Hasselgren, L.; Stroem, S.; Thun, J.-E.; Antman, S. (Uppsala Univ. (Sweden). Inst. of Physics). Aug 1969. 19p. Dep. CFSTI (U. S. Sales Only).

Four transitions in ^{133}Cs were studied by measurements of relative conversion electron intensities and electron-gamma directional correlations. The transitions studied, 276, 223, 161 and 80 keV respectively, have in common that they feed and de-excite the 161-keV level in ^{133}Cs. In addition the L-subshell ratios for the 81-keV transition were measured and analysed. The 161- and 223-keV transitions show penetration effects in the internal conversion process. (auth)

26643 (UUIP–651) ALPHA–GAMMA ANGULAR CORRELATION AND HYPERFINE INTERACTION IN THE DECAY OF ^{249}Cf. Falk, F.; Linnfors, A.; Orre, B.; Thun, J. E. (Uppsala Univ. (Sweden). Inst. of Physics). Aug 1969. 40p. Dep. CFSTI (U. S. Sales Only).

The angular correlation between the main α-transition (5.81 MeV) and the following 388 keV E1 gamma transition (and in one case also the 333 keV E1 transition branching from the same level) in the decay of ^{249}Cf to ^{245}Cm was studied. Thin sources were used. The recoiling daughter ions are allowed to escape into vacuum. The strong hyperfine interaction perturbing the correlation in this case was neutralized by a longitudinal decoupling field with a strength of some kilogauss. The correlation was also studied in silver and nickel surroundings where it was found to be almost unperturbed. In an insulator a strong perturbation was found which was not influenced by the longitudinal field. The unperturbed values of the A_{22}-coefficients do not support the mixing ratios ($L = 0$, $L = 2$, $L = 4$) from the Bohr–Froeman–Mottelson theory. A computer program for calculation of the combined (static) hyperfine and external magnetic interaction is developed, and the results of some calculations are presented. (auth)

26644 (UUIP–652) CONVERSION PROBABILITY OF THE 35-keV TRANSITION IN ^{125}Te. Marelius, A.; Vaelivaara, K.-G.; Awwad, Z.; Lindskog, J.; Pihl, J.; Haegglund, S.-E. (Uppsala Univ. (Sweden). Inst. of Physics). Aug 1969. 5p. Dep. CFSTI (U. S. Sales Only).

The probability for K-conversion of the 35 keV M1 + E2 transition was determined from coincidences between Auger electrons and conversion electrons. The result is $k_K = 0.804 \pm 0.010$. The decay of the 58 days metastable 145 keV ($^{11}/_{2}$ –) level in ^{125}Te consists of two transitions in cascade, a 109 keV M4 transition to the 35 keV ($^{3}/_{2}$ +) state followed by a 35 keV M1 + E2 transition to the ($^{1}/_{2}$ +) ground state. Measurements of relative conversion intensities require in this case knowledge of electron detector efficiency over a wide energy range. The experimental methods make use of either x-rays of Auger electrons to derive conversion probabilities. Coincidences between Auger electrons and conversion electrons are used in the present measurement. The advantage is that, for deriving the K-conversion probability, no knowledge of detector efficiencies or fluorescent yield is required. (auth) (SW)

26645 INTENSITY ANOMALY IN THE (d,pγ) REACTION. Bartholomew, G. A.; Bergqvist, I.; Earle, E. D.; Ferguson, A. J. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys.; 48: 687-709(15 Mar 1970). (AECL-3509).

The spectra of gamma rays detected in coincidence with protons from the (d,pγ) reaction in elements $108 \le A \le 134$ and $182 \le A \le 210$ were measured in gross structure with a NaI detector. The region of excitation energies covered in the product nuclei was from 0.8 MeV to about the neutron separation energy, typically 7 MeV. The gamma-ray anomalous bump at about 5.5 MeV was found from regions near the separation energy with an intensity comparable to that previously observed in (n,γ) reactions. By gating techniques the decay of many contiguous intervals of excitation energy, populated in the reaction, was studied. From the results, a strength function for gamma rays between 0.8 and 7 MeV approximately was extracted for Au, where the bump is prominent, and for Ta where the bump is essentially absent. In the particular case of ^{206}Pb(d,pγ)^{207}Pb, the gamma-ray spectra are interpreted in terms of the decay of known single particle states. An interpretation of the intensity anomaly in terms of doorway states is discussed. (auth) (Canada)

26646 CAPTURE CROSS SECTION OF ^{242}Pu. Durham, R. W.; Molson, F. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys.; 48: 716-24(15 Mar 1970). (AECL–3528).

The neutron capture cross section of ^{242}Pu was measured by determining the ^{243}Am product. Samples were irradiated in a neutron flux having essentially a Maxwellian distribution defined by the temperature (37.5°C) of a water annulus around the sample tube. Plutonium and americium were separated from each other chemically and their concentrations and isotopic compositions obtained by low-geometry α counting and α spectrometry. A value for $g\sigma_0$ of 18.7 ± 0.7 b was obtained where g represents the deviation from 1/v behavior. (auth) (Canada)

26647 SPECTROSCOPIC DETERMINATION OF THE NUCLEAR MOMENTS OF BISMUTH. Crooker, A. M.; Shipley, G. (Univ. of British Columbia, Vancouver). Can. J. Phys.; 48: 730-6(15 Mar 1970).

The nuclear magnetic moment μ, and the electrostatic quadrupole moment Q, were obtained from the spectra of Bi II, III, and IV. μ, derived from the one-electron hyperfine structures of Bi III was 4.23(0.10) nuclear magnetons. μ, derived from hyperfine structures of sl configurations of Bi II and Bi IV, was 3.7(0.5) nm. Q, derived from sl configurations of Bi II, was −0.4(0.1) b; hyperfine structures of Bi IV yield values from 0.79 to −20 b. Three new "A" factors for Bi II are also presented. (auth) (Canada)

26648 FISSION FRAGMENT ANGULAR DISTRIBUTION IN PROTON-INDUCED FISSION OF ^{209}Bi. Gadioli, E.; Iori, I.; Molho, N.; Zetta, L. (Univ., Milan. Istituto Nazionale di Fisica Nucleare, Milan). Lett. Nuovo Cim.; 2: 904-8(21 Dec 1969).

The angular distributions of fragments from the proton-induced fission of ^{209}Bi were measured at ten proton energies between 30.6 and 44.5 MeV. The energy dependence of the anisotropy parameter K_0^2 was evaluated. (J.W.R.)

26649 ON THE BETA DECAY OF ^{237}Pa. von Egidy, T. (Technische Hochschule, Munich); Morinaga, H.; Lingeman, E. W. A.; Polak, P. Z. Naturforsch.; 24a: 1831(Nov 1969).

The gamma spectra from a U_3O_8 target was measured 30 min after bremsstrahlung irradiation in order to check the half-life of ^{237}Pa produced by the reaction ^{238}U(γ,p). The results indicate that a previous assignment of 39 min to ^{237}Pa is incorrect. (J.W.R.)

26650 MEASUREMENT OF THE SPECIFIC CONSTANT OF GAMMA RADIATION FROM ^{125}I. Guiho, Jean-Paul; Le Gallic, Yves (CEA, Gif-sur-Yvette, France). Compt. Rend., Ser. B; 269: 590-2(29 Sep 1969). (In French).

A determination was made of the specific constant of gamma radiation from ^{125}I with the help of a chamber with inner surfaces of air; a comparison was made of the obtained experimental value with the theoretical value. (tr-auth)

26651 SLOW NEUTRON TOTAL CROSS SECTIONS AND RESONANCE LEVELS OF $^{187\ 188\ 189}$Os. Vertebnyi, V. P.; Vlasov, M. F.; Dadakina, A. F.; Zatserkovskii, R. A.; Kirilyuk, A. L.; Pasechnik, M. V.; Trofimova, N. A. (Inst. of Physics, Kiev). Ukr. Fiz. Zh.; 14: 1968-71(Dec 1969). (In Russian).

The transmissions of the samples enriched by the osmium isotopes −187, −188, −189 as well as natural osmium for 0.006 to 150 eV neutrons were measured. Osmium-187 total neutron cross-section energy dependence in the range 0.006 to 0.3 eV is given. $\sigma_t = 344 \pm 12$ barns at v = 2200 m/sec. Such a large cross section may be due to the contribution of the first negative level since a positive level contribution to the cross section is only 6 barns. Resonance level energies of osmium-187, -188 and -189 are presented. Level densities of the isobaric nuclei of osmium-187 and rhenium-187 as well as osmium-189 are compared. (auth)

26652 DEVELOPMENT OF THE L X-RAY INTENSITY PATTERN METHOD FOR MULTIPOLARITY DETERMINATION AND ITS APPLICATION TO ^{182}Ta. Stabenau, Walter Frank. Ithaca, N. Y.; Cornell Univ. (1969). 79p.

Thesis.

A new method was developed for determining the multipolarity and energy of low energy, highly converted nuclear transitions. For transitions below the K shell binding energy, only relative intensities of the Lα, Lβ, and Lγ x rays resulting from the transition need be observed, and difficulties associated with L and M conversion electron intensity measurements thereby avoided. Theoretical L x-ray intensity ratios Lβ/Lα and Lγ/Lα, were calculated for tantalum from internal conversion coefficients, fluorescence yields, and Coster-Kronig transition probabilities as a function of energy and multipolarity. Natural tantalum samples 0.15 micron thick were neutron activated. The L x-ray activity of the sample was observed with a high resolution Ge(Li) detector capable of resolving the 7 to 13 keV x rays into their Lα, Lβ, and Lγ components, and the spectrum recorded with a 1024 channel analyzer. The resultant L x-ray ratios (corrected for absorption effects) were 1.005 ± 0.018 for Lβ/Lα, and 0.193 ± 0.006 for Lγ/Lα. No gamma rays or K x rays were observed in the decay spectrum. The observed half life was 283 ± 3 milliseconds. Comparison of experimental and calculated values indicated only an E1 or an M2 transition multipolarity was possible for the isomeric transition. Calculations of L x-ray intensities and corresponding unconverted gamma ray intensities indicated that a gamma ray should have been easily observable for an E1 multipole. Hence, the transition multipolarity could only be M2. With this new information, a corrected level scheme was deduced for the 16-minute ^{182}Ta isomeric decay, the 283-msec isomeric transition terminating the decay to the ground state, and new spins and parities of levels were assigned, with 5^+ and 10^- for the 283-msec and 16-minute isomeric levels respectively. A rough determination of the cross section for the 283-msec isomer of approximately seven barns compared favorably with the cross sections calculated by the statistical theory of Huizenga and Vandenbosh, thus giving added strength to the new level assignments. (Disser. Abstr.)

26653 EXTRAPOLATION AND INTERPOLATION IN CALCULATION OF THE RESONANCE ABSORPTION OF NEUTRONS OF INTERMEDIATE ENERGY. Mikkelsen, Joern (Danish Atomic Energy Commission Research Establishment, Risoe). Nucl. Sci. Eng.; 39: 403-7(Mar 1970).

A generalization of the intermediate resonance method for the calculation of neutron resonance integrals is proposed. Requirements on the interpolation parameter λ_k are dropped and an extrapolation is used. The results achieved are accurate but the method is complicated by the fact that the solutions are no longer unique. Resonance integrals of ^{238}U are calculated as an example. (J.W.R.)

26654 STUDY OF ISOBARIC ANALOGUE STATES IN ^{143}Pm BY ELASTIC AND INELASTIC PROTON SCATTERING FROM ^{142}Nd. Grosse, E.; Melchior, K.; Seitz, H.; Von Brentano, P.; Wurm, J. P.; Zaidi, S. A. A. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Nucl. Phys.; A142: 345-58(1970).

Excitation functions of elastic and inelastic proton scattering from ^{142}Nd were taken between 9 and 11.4 MeV at various angles. A detailed analysis of the elastic data with an S-matrix consisting of a sum of Breit–Wigner terms and a phenomenological background term was performed and highly accurate resonance parameters are presented. The error for the partial widths, defined by the Breit–Wigner expression is of the order of 8%. The extracted parameters are discussed. Excitation functions and angular distributions, taken at resonance energies reveal the rather complicated structure of the 2^+ state in this spherical even nucleus. (auth)

26655 ISOMERIC STATES IN THE REGION Z > 50, N < 82 PRODUCED IN (^{12}C,xn) REACTIONS. Conlon, T. W. (Atomic Energy Research Establishment, Harwell, Eng.); Elwyn, A. J. Nucl. Phys.; A142: 359-68(1970).

The gamma-ray spectra from new isomeric states in Xe, Ba, and La isotopes formed in the ^{12}C ion bombardment of isotopes of Cd, Sn and Sb were studied. Isomeric activity was assigned to the odd-mass nuclei ^{121}Xe, ^{123}Xe, ^{125}Ba, ^{129}La and ^{131}La. The lack of isomers attributable to doubly even nuclei in this region is discussed. (auth)

26656 SPIN AND PARITY ASSIGNMENTS IN ^{93}Nb. Sharma, H. C.; Nath, N. (Banaras Hindu Univ., India). Nucl. Phys.; A142: 291-9(1970).

The available experimental data on ^{93}Nb(n,n′) and ^{93}Nb(n,n′γ) reaction cross sections were examined in order to assign spins and parities to low-lying excited states in ^{93}Nb. Three different optical-model potentials, all compatible with the observed angular distribution of elastically scattered neutrons from ^{93}Nb, were employed to derive the neutron penetrabilities. It was found that the excitation functions for individual states of ^{93}Nb calculated theoretically do not seem to depend much on the shape of the imaginary potential. The role of level-width fluctuations is also discussed. (auth)

26657 INTERNAL CONVERSION STUDIES OF TRANSITIONS POPULATING AND DEPOPULATING THE 161 keV LEVEL IN ^{133}Cs. Toernkvist, S.; Hasselgren, L.; Stroem, S.; Thun, J.- E.; Antman, S. (Inst. of Physics, Uppsala). Nucl. Phys.; A142: 238-50(1970).

Four transitions in ^{133}Cs were studied by measurements of relative conversion electron intensities and electron-gamma directional correlations. The transitions studied, 276, 223, 161 and 80 keV respectively, all feed and de-excite the 161-keV level in ^{133}Cs. In addition the L-subshell ratios for the 81-keV transition were measured and analyzed. The 161- and 223-keV transitions show penetration effects in the internal conversion process. The penetration effects in the 223-keV transition are reported for the first time. (auth)

26658 CALCULATION OF δ OF r^2 FOR MOESSBAUER TRANSITIONS USING CORIOLIS MIXED WAVE FUNCTIONS. APPLICATION TO ^{153}Eu. Hess, John (Hebrew Univ., Jerusalem). Nucl. Phys.; A142: 273-90(1970).

An energy fit to the positive parity levels of ^{153}Eu was carried out. From the energy fit, Coriolis mixed wave functions were obtained and compared with the extensive experimental data available for B(E2) and B(M1) reduced transition probabilities, magnetic moments, branching ratios and isomer shifts. In general, good agreement was obtained. However, there is a striking exception for the $\delta\langle r^2\rangle$ (difference in mean square radius) associated with the 103.2-keV transition. For this case the theoretical estimate of $\delta\langle r^2\rangle_{103.2}$ was six times larger than the experimental value. A simple quantum mechanical formulation for $\delta\langle r^2\rangle$ is given and it is shown that the very large 103.2 keV $\delta\langle r^2\rangle$ can be calculated almost as well using a classical formulation. Thus the origin of such a large discrepancy is unclear. (auth)

26659 THE 93.54 keV LEVEL IN ^{91}Sr. Malmskog, Sven G. (Aktiebolaget Atomenergi, Studsvik, Sweden); McDonald, John. Nucl. Phys.; A142: 263-72(1970).

An intense transition of 93.54 keV is seen in the decay of ^{91}Rb ($T_{1/2}$ = 58.2 sec), and is assigned to a level at this energy in ^{91}Sr. The energy level is accurately measured with a Ge(Li) detector. The half-life of the level is found by direct timing to be 88 ± 3 ns. Measurement of the conversion electron spectrum with a long-lens spectrometer has enabled the E2/M1 ratio to be deduced. The nature of the ground and excited states of N = 53 nuclei is discussed in terms of configurations of $2d_{5/2}$ neutrons. (auth)

26660 ON THE DESCRIPTION OF FERMION SYSTEMS IN BOSON REPRESENTATIONS. IV. NUMERICAL CALCULATION OF QUADRUPOLE EXCITATIONS IN Cd, Sn, Te, Sm, AND Pb. Soerensen, Bent (Univ. of California, Berkeley). Nucl. Phys.; A142: 411-44(1970).

Quadrupole vibrational excitations are described in a modified quadrupole-plus-pairing model, using the boson expansion method. The radial dependence of the quadrupole force is chosen so as to yield as an average field a Wood–Saxon type potential. A qualitatively correct description is provided for the phase transition in the Sm isotopes, but the energy spectra, transition probabilities and static quadrupole moments of nuclei near closed shells are barely consistent with experiment, the most puzzling disagreement being the sign of the static quadrupole moment of the first 2^+ state in ^{122}Te. (auth)

26661 A STUDY OF ROTATIONAL STATES OF ^{158}Dy, ^{162}Er, ^{164}Er, ^{168}Yb, AND ^{174}Hf EXCITED BY NEUTRON EVAPORATION REACTIONS. Jett, James Hubert. Boulder, Colo.; Univ. of Colorado (1969). 154p.

Thesis.

A series of rotational bands in ^{158}Dy, ^{162}Er, ^{164}Er, ^{168}Yb, and ^{174}Hf were studied by excitation with neutron evaporation reactions initiated by protons, deuterons, ^{3}He and α-particles with energies between 16 and 28 MeV. The resulting prompt gamma ray spectra were analyzed with a curved crystal diffraction spectrometer and with lithium-drifted germanium detectors. The diffraction spectrometer, which was installed on-line with the cyclotron, was used to make energy measurements of the first four transitions in the ground state bands of all the nuclei except ^{162}Er. Cross section and energy measurements for all the nuclei were made with Ge(Li) detectors. Transitions from levels in the ground state bands were seen up to 10^+ in ^{168}Yb, 12^+ in ^{158}Dy, ^{162}Er, and ^{174}Hf and 14^+ in ^{164}Er. The γ-vibrational bands in three of the nuclei were strongly excited and several β-bands were weakly excited. The energy levels deduced from the measurements were successfully fit by the empirical formulas of Holmberg and Lipas and of Sood for the ground state band as well as for the higher bands. The formula of Holmberg and Lipas, which can be derived by assuming linear dependence of the moment of inertia on the excitation energy, fits the energy levels of essentially all the bands identified and agrees with all models proposed to date. This formula can be derived from a model of a nucleus which assumes centrifugal stretching with a quadratic restoring force. The cross sections for transitions in the ground state band agree with the statistical model calculations made which are based on a charged completely absorbing model of the nucleus for calculation of the formation cross section and on Ericson's statistical theory for calculation of the neutron evaporation. Within the validity of the calculations made, no angular momentum deficit was observed, i.e., there is no difference between the observed angular momentum distribution and model predictions. (Diss. Abstr. Int., B)

26662 THE LIFETIME INVESTIGATION OF EXCITED STATES OF GADOLINIUM NUCLEI. Balanda, A. (Inst. of Nuclear Research, Krakow); Gonsior, M.; Kuznetsov, V. V.; Lizurei, G. I.; Menchinski, V.; Mikhailov, M. Acta Phys. Pol.; 36: 1099-1103(Dec 1969). (In Russian).

The half-life of ^{151}Tc measured by the activity of 108.1-keV conversion electrons was found to be $T_{1/2}$ = (16.5 ± 0.3) h. The lifetimes of lower excited states of ^{148}Gd, ^{151}Gd, and ^{152}Gd were determined by the e–e coincidence method. The half-life of the 164.5-keV ($5/2^-$) state in ^{148}Gd is $T_{1/2} = (1.35 \pm 0.30) \times 10^{-9}$ sec. The half-life.

periods of ^{151}Gd states with energies of 108.1 keV ($^5/_2{}^-$), 395.2 keV ($^3/_2{}^-$), and 587.5 keV ($^5/_2$) are (2.72 ± 0.2) × 10^{-9} sec,(0.32 ± 0.04) × 10^{-9} sec, and ≤ 0.3 × 10^{-9} sec, respectively. The half-life of the ^{152}Gd state at 344.4 keV (2^+) energy was estimated to be $T_{1/2}$ ≤ 0.3 × 10^{-9} sec. (tr-auth)

26663 REACTIONS OF ^{197}Au WITH 19- TO 100-MeV ^{4}He IONS: EQUILIBRIUM STATISTICAL MODEL ANALYSES. Lanzafame, F. M.; Blann, M. (Univ. of Rochester, N. Y.). Nucl. Phys., A142: 545-58(1970).

Excitation functions and mean recoil ion ranges were measured for reactions induced in ^{197}Au with 19 to 100 MeV ^{4}He ions. Excitation functions for the production of ^{195,196}Tl, ^{197,198,198m,199,200}Tl, ^{195m,197m}Hg and ^{194,195,196,198}Au are reported. Recoil ranges indicate that the (α,xn), x = 1-6 reaction products are generally consistent with a compound nucleus mechanism, whereas the (α,α′n) reaction product ranges indicate a non-compound mechanism. The (α, xn), x = 2-5 excitation functions are analyzed in terms of the statistical model, using a standard Fermi gas level density but allowing the level spacing parameter a to be varied. Results of calculations using the s-wave approximation in which a variable level spacing parameter was used are also presented. Effects of varying the nuclear moment of inertia in calculating γ-ray emission limits are explored. Results indicate a best value of a between 16 and 24 MeV^{-1}, which is consistent with the Fermi gas model prediction of A/8 MeV^{-1} for the level density used. (auth)

26664 ENERGY LEVELS OF ^{133}Cs AND ^{141}Pr FROM THE (n,n′γ) REACTION. Dave, V. R.; Nelson, J. A.; Wilenzick, R. M. (Tulane Univ., New Orleans). Nucl. Phys., A142: 619-33(1970).

The energy levels of ^{133}Cs and ^{141}Pr were studied by high-resolution measurements of γ-rays following neutron inelastic scattering for incident neutrons in the range 0.2–2.2 MeV. The observed γ-rays were assigned to transitions from levels up to an excitation of 1175 keV in ^{133}Cs and 2104 keV in ^{141}Pr. Ten new levels in ^{133}Cs above 437 keV are proposed. The level scheme of ^{141}Pr is compared with previous work and a number of discrepancies resolved. Differential γ-ray production cross sections at 95° are presented. (auth)

26665 MEASUREMENT OF THE STATIC QUADRUPOLE MOMENTS OF THE FIRST 2^+ STATES IN ^{104} ^{106}Pd AND ^{130}Te. Christy, A.; Hall, I.; Harper, R. P.; Naqib, I. M.; Wakefield, B. (Univ. of Liverpool). Nucl. Phys., A142: 591-603(1970).

By measurement and comparison of the probabilities of Coulomb excitation by ^{4}He and ^{16}O ions of the first 2^+ states of ^{104,106}Pd and ^{130}Te the electric quadrupole moments of these states were deduced. These are compared with results for other isotopes of Pd and Te. (auth)

26666 PERTURBED ANGULAR DISTRIBUTIONS FROM $^{120\ 122\ 124}$Sn(^{40}Ar,4n)$^{156\ 158\ 160}$Er REACTION PRODUCTS RECOILING IN VACUUM. Nordhagen, R.; Goldring, G.; Diamond, R. M.; Nakai, K.; Stephens, F. S. (Univ. of California, Berkeley). Nucl. Phys., A142: 577-90(1970).

Intensity ratios, W(0°)/W(90°), were measured for γ-rays emitted from products of ^{120,122,124}Sn(^{40}Ar,4n)^{156,158,160}Er reactions recoiling into either vacuum or lead. The g-factors for levels in the ground bands (with spins up to 8) of the Er nuclei are evaluated. The perturbation of the angular distribution due to time-dependent hyperfine interactions in highly excited, free ions was found to be strongly dependent on the nuclear spin I and the atomic spin J. The average g-factor for the three Er nuclei ground bands was found to be between 0.34 and 0.40 depending on assumed models of the I and J dependence. No large difference in g-factors among the nuclei was found, although a small increase (≈ 20%) between ^{160}Er and ^{156}Er seems indicated. (auth)

26667 MEASUREMENT OF THE (n,2n) CROSS SECTIONS ON HEAVY NUCLEI. Winkler, G.; Hille, P. Oesterr. Akad. Wiss. Math.-Naturwiss. Kl., Anz.; 105: 321-4(1968). (In German).

The total (n,2n) cross sections of ^{140}Ce, ^{142}Ce, ^{160}Dy, ^{166}Er, ^{169}Tm, ^{170}Yb, ^{176}Hf, ^{182}W, ^{204}Hg, ^{203}Tl, and ^{204}Pb were measured at neutron energy of 14.7 ± 0.15 MeV by the activation method relative to the cross section $\sigma(^{27}\mathrm{Al}(n,\alpha)^{24}\mathrm{Na})$ = 111.5 ± 2 mb. No unexpected small effective cross sections were found. The average (n,2n) cross sections were only about 10 to 15% smaller than the corresponding total non-elastic cross sections. The results showed no marked shell effects and no reference points connected with (g-g) nuclei and nuclei with uneven mass number. (J.S.R.)

26668 SYSTEMATICS OF (n,α), (n,p), AND (n,2n) CROSS SECTIONS OF MEDIUM-HEAVY NUCLEI FOR 14.5-MeV NEUTRONS. Hille, P. Oesterr. Akad. Wiss. Math.-Naturwiss. Kl., Anz.; 105: 364-5(1968). (In German).

Experimental values for (n,α), (n,p), and (n,2n) effective cross sections were compiled from the literature, and the incorrect data were eliminated. The remaining cross section averages have error limits <30%. The neutron cross sections show some clear systematic relations. The symmetry parameter (N – Z)/A (or a similar parameter) appears to play an essential role. No indication of shell effects was found. The cross sections of even nuclei do not appear to differ essentially from that of their neighboring nuclei with uneven mass numbers. (J.S.R.)

26669 STUDIES ON TERNARY FISSION OF URANIUM. PART 6. DETECTION OF THE FISSION CHAIN ^{166}Dy–^{166}Ho–^{166}Er AND FISSION YIELD DETERMINATION. Muenze, R. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger); Grosse-Ruyken, H.; Wagner, G. Kernenergie; 12: 380-2(Dec 1969). (In German).

In carrying out experiments of separation in the range of the heavy fission products of ^{235}U a new fission chain ^{166}Dy – ^{166}Ho – ^{166}Er was detected and the fractional fission yield of ^{166}Dy was found to be 6 × 10^{-8}%. The comparison with fission yields in the range of the light fission products (^{66}Ni/^{66}Cu: 2 × 10^{-8}%, ^{67}Cu: 6 × 10^{-8}%) formerly determined shows that they probably were products of binary fission also in this range. The upper limit of ternary to binary fission ratio determined by a radiochemical technique is found to be about 10^{-7}. (auth)

26670 THE EMISSION PROBABILITY OF THE 121.2 keV γ RAY IN THE DECAY OF ^{147}Pm. Mowatt, R. S.; Merritt, Janet S. (Atomic Energy of Canada Ltd.; Chalk River, Ont.). Can. J. Phys.; 453-8(15 Feb 1970). (AECL-3498).

The emission probability, P_γ, of the 121.2-keV γ ray in the decay of ^{147}Pm was measured to be (2.7 ± 0.2) × 10^{-5} gammas per disintegration. The γ-ray counting rate for ^{147}Pm sources was determined using a Ge(Li) planar diode and calibrated sources of ^{57}Co which emit a 122.0-keV γ ray. The ^{147}Pm disintegration rate was determined by the $4\pi\beta-\gamma$ tracer method employing ^{46}Sc as the tracer. (auth) (Canada)

26671 COMPUTER PROGRAM FOR DETERMINATION OF HALF-LIVES AND INTENSITIES FROM COMBINED DECAY CURVES OF RADIOACTIVITY. Uhl, M. Oesterr. Akad. Wiss. Math.-Naturwiss. Kl., Anz.; 105: 48-54(1968). (In German).

A computer program for the determination of half-lives and intensities from combined decay curves of radioactivity was developed. The program was described in Fortran II-D. The solution method is outlined, and the program is described and illustrated schematically. (J.S.R.)

26672 A 31-ms ISOMERIC ACTIVITY IN ^{155}Gd. Liukkonen, E.; Pursiheimo, V.; Tuurnala, T. (Univ. of Helsinki). Ann. Acad. Sci. Fenn., Ser. A VI; No. 325, 8p(Nov 1969).

A 31 ± 2 ms isomeric activity which is assigned to ^{155}Gd was produced through the reaction ^{156}Gd(n,2n)^{155}Gd with 14- to 15-MeV neutrons. The 31 ms activity contains Gd K x-rays and a 86.5-keV E1-transition, which corresponds to a well-known E1-transition depopulating the 86.5-keV level in ^{155}Gd. The most probable candidates for the isomeric state in ^{155}Gd lie at 105 keV ($^9/_2{}^+$) and at 118 keV ($^{11}/_2{}^-$). (auth)

Nuclear Theory

Refer also to abstracts 26444, 26533, 26582, and 26660.

26673 (COO-535-606) INSTRUCTIONS FOR THE USE OF DWUCK: A DISTORTED WAVE BORN APPROXIMATION PROGRAM. Kunz, P. D. (Colorado Univ., Boulder. Dept. of Physics). 8 Aug 1969. 20p. Dep. CFSTI.

Instructions for the use of the distorted-wave Born approximation program DWUCK are presented including the microscopic interaction and two-nucleon transfer. (J.F.P.)

26674 (FEI-134) STATISTICAL DESCRIPTION OF FISSION PRODUCT YIELDS. Ignatyuk, A. V. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut). 1969. 32p. (In Russian). Dep. CFSTI (U. S. Sales Only).

The effect of the shell structure of a single-particle spectrum on the energy, deformation and density of excited states of fission fragments was studied. The mass and charge yields and the distribution of average kinetic energies of fragments of a given mass were calculated within the framework of the statistical theory of fission (P. Fong, Phys. Rev., Vol. 102: 434, 1956).

26675 (LA-4373) TIME REVERSAL IN POLARIZATION PHENOMENA OF NUCLEAR INTERACTIONS. Keaton, P. W. Jr. (Los Alamos Scientific Lab., N. Mex.). Jan 1970. Contract W-7405-eng-36. 44p. Dep. CFSTI.

The concept of "time reversal invariance" is reviewed along with some basic properties of the time reversal operator, T. Applications to specific nuclear physics problems are given which demonstrate methods of manipulating T in a calculation. Using the density matrix formalism, a relation is derived between polarization transfer (triple scattering) experiments that describe reactions and inverse reactions with initially polarized particles. The fundamental relations are illustrated by examples. Relativistic effects and photon polarizations are not discussed. (auth)

26676 (RD/B/N–1427) FISSION PRODUCT INVENTORIES. PART I. THE CALCULATIONAL METHOD AND PROGRAM FISP. Clarke, R. H.; Utting, R. E. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Aug 1969. 31p. Dep. CFSTI (U. S. Sales Only).

The equations governing the production and decay of fission products have been programmed for the IBM 360/75 computer. The program, which has been called FISP, considers all fission products with half-lives greater than about 1 second between ^{72}Zn and ^{161}Tb, and the yields of these fission products are tabulated for thermal fission in ^{235}U, ^{239}Pu and ^{241}Pu and for fast fission in ^{235}U, ^{239}Pu, ^{241}Pu and ^{238}U. Details for running the program are presented together with instructions for modifications to the yield values either for revised data or for alternative fission sources. (auth)

26677 (UCRL–19391) STOPPING POWER, RANGE, AND TERMINAL IONIZATION OF ANY NUCLEUS WITH 0.01 TO 500 MeV/amu IN ANY NONGASEOUS MATERIAL, INCLUDING NUCLEAR EFFECTS. Wallace, Roger; Litton, Gerald M.; Steward, Palmer G. (California Univ., Berkeley. Lawrence Radiation Lab.). 29 Apr 1969. Contract W-7405-eng-48. 69p. (CONF-691101–17). Dep. CFSTI.

From 2nd International Conference on Accelerator Dosimetry and Experience, Stanford, Calif.

Several methods are combined to provide the range, stopping power, and Bragg peak data for any heavy ion with energy lying between 0.01 and 500 MeV per amu when incident on any nongaseous stopping medium. A FORTRAN IV program providing both numerical data and machine plots is available, so that any new particle or new stopping medium whether an element or a compound can be quickly evaluated in detail. For ions at low energy with $Z \leq 10$, the program uses experimental data. For ions with $Z \geq 10$, the nuclear and electronic stopping-power theory developed by Lindhard et al. is adjusted to fission-product range data at low energy; for intermediate energies, charge-state data developed from experimental Ar range-energy data in Al is extended to other ions and stopping media. Bethe's theory is used for all ions at high energy. Bloch's theory is discussed, although it is not used in the method. The particle ranges calculated by the method are pathlength ranges and do not include the effects of multiple scattering. Using the calculated range energy and energy loss data, a method is described to calculate Bragg curves, flux curves, and energy spectra. Energy loss from electronic and nuclear elastic collisions, nuclear attenuation, small-angle multiple scattering, straggling initial energy, and angular spreads of the beam are all taken into consideration. Contributions from secondary particles have been estimated. It is found that for a given range in a particular target, the peak-to-plateau dose ratio goes through a maximum as the atomic number of incident ions increases. Similarly, the Bragg peak full width at half-maximum goes through a minimum. In addition for a given range, the average energy per atomic mass unit at the Bragg peak is nearly independent of the bombarding ion, and also of the target material. Calculated results agree well with experimental data for those cases in which secondary-particle production is of minor importance. Even when secondaries are a large contributing factor, the method yields valuable information regarding the variation in energy deposition by the primary particles. The results are found to be quite sensitive to the degree of angular and energy spread of the initial beam. (auth)

26678 USE OF PERTURBATION THEORY AND STATISTICAL CONCEPTS IN NUCLEAR STRUCTURE STUDIES WITH APPLICATION TO THE GROUND STATE OF ^{14}N. Ullah, N.; Wong, S. S. M.; Trainor, L. E. H. (Univ. of Toronto). Can. J. Phys.; 48: 842-6(1 Apr 1970).

A statistical theory due to Ullah in which the dominant configuration of a nuclear state is identified, and the remainder treated statistically, is modified to include an energy weighting factor. When applied to the problem of ^{14}N the modified theory predicts a 10–20% admixture of 2s–1d configurations in the ground state. (auth) (Canada)

26679 SENIORITY MIXING IN ODD-ODD NUCLEI. Nomura, M. (Tokyo Univ.). Lett. Nuovo Cim.; 3: 98-100(15 Jan 1970).

The seniority mixing in odd-odd nuclei is measured by studying the quantity $\Sigma_{\alpha J_0} \langle j_1^3(v = 1 j_1) j_2 J | V' | j_1^3(v = 3, \alpha, J_0) j_2 J\rangle^2$, where v is the seniority, α the additional quantum number, and j_1 and j_2 the spins of a proton (or neutron) and a neutron (or proton) shell respectively. Results obtained from applying the quantity to perform the second-order perturbation calculation of odd-odd nuclei with 3 protons and 1 neutron—with the odd group model approximately holding, the energy denominators independent of α, J_0, and J_1—, and the proton-neutron and proton–proton interactions of the form $(1 + 0.1(\sigma \cdot \sigma))\delta$—are presented as being the following: the seniority mixing is largest for $J = j_1 + j_2 - 1$ and smallest for $J = j_1 + j_2$, and the J-dependence of the energy becomes small due to the effect of seniority mixing. (L.W.A.)

26680 PARAMETRIC METHOD FOR CALCULATING COULOMB ENERGY OF VARIOUS FORMS OF FISSIONING NUCLEI. Adeev, G. D.; Cherdantsev, P. A. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 12, 127-9(1969). (In Russian).

A modified nuclear drop model was used for calculating the Coulomb energy of certain fissioning nuclei. Considering that the calculations of the Coulomb energy for an ellipsoid can be reduced simply to the calculation of (1/r), an attempt was made of using the same averaging for strongly deformed nuclei, differing from ellipsoid. Simple formulas were obtained for calculating the Coulomb energy of deformed nuclei on the basis of averaging 1/r inside the volume. The Coulomb energy in units of $^3/_5\,(Z^2e^2/R_0)$ is tabulated. (R.V.J.)

26681 SHELL AND ISOTOPE EFFECTS IN HIGH-EXCITED NUCLEI. Pasechnik, M. V. (Inst. of Physics, Kiev). Ukr. Fiz. Zh.; 14: 1958-67(Dec 1969). (In Russian).

A review is presented of new data on shell and isotope effects detected while studying high-excited states of nuclei and the physical interpretation of the obtained results. Isotope dependence is observed in level density of nuclei excited up to high states. Isotope dependence of differential cross sections and angular distributions of polarization is described within the framework of an optical model. (auth)

26682 ON THE DIFFRACTION SCATTERING THEORY. Kresnin, A. A.; Tishchenko, B. I. (Inst. of Physics and Tech., Kharkov). Ukr. Fiz. Zh.; 14: 1998-2003(Dec 1969). (In Russian).

Formulas are obtained for the cross sections of elastic and inelastic diffraction scattering of particles by nuclei for the case of the scattering matrix in the form of the Fermi step superpositions. It is shown that such a form of the scattering matrix gives rise to substantial changes in the period, depth of oscillations and absolute values of the diffraction scattering cross sections. (auth)

26683 QUADRUPOLE CORRECTIONS TO THE RUTHERFORD SCATTERING OF CHARGED PARTICLES. Clement, C. F. (Atomic Energy Research Establishment, Harwell, Eng.). Ann. Phys. (N. Y.); 56: 198-223(Jan 1970).

For a nucleus with a static ground state quadrupole moment the elastic scattering amplitude for a charged particle contains a first-order term, proportional to Q, describing a reorientation of the ground state. The term is obtained in perturbation theory together with second-order E1 and E2 terms and resulting cross sections for unpolarized and polarized targets are given. For the latter there is a first-order quadrupole contribution to the cross section. The quadrupole term is calculated by an expansion in η^{-1}, where η is the Coulomb parameter, and by an expansion in partial waves. The results of scattering on a target completely polarized along the beam direction are shown to be well-described by a classical theory when η is greater than unity. At $\theta = \pi$ this classical quadrupole cross section assumes the simple form, $Q/10\ Z_2$, independent of all characteristics of the bombarding particle, where Z_2 is the charge of the target. In energy regions where nuclear effects are negligible it is found that, although virtual E1 effects are negligible for most charged particles, there are considerable E2 and quadrupole contributions to cross-sections. However first order perturbation theory works only for light incident particles such as muons. The elastic scattering of muons from polarized nuclei would provide a method for the determination of large nuclear quadrupole moments. (auth)

26684 CHARGE-EXCHANGE REACTIONS OF PIONS ON NUCLEI. Westroem, M. (Institut fuer Theoretische Physik, Marburg, Ger.). Nucl. Phys.; A142: 321-9(1970).

The cross sections for the reactions $(\pi^{\pm},\pi^0)$ on nuclei are calculated in the energy around the (3,3) resonance using the impulse approximation. It is shown that the cross sections in particular contain information about the proton-neutron correlations in nuclei; information not usually contained in the cross sections for the usual electron scattering on nuclei. Numerical estimates are given in the case of charge exchange scattering on ^{16}O and ^{13}C. The results were not found to be in agreement with the available data as long as the initial and final state interactions were neglected. (auth)

26685 ON THE DESCRIPTION OF FERMION SYSTEMS IN BOSON REPRESENTATIONS. III. NORMAL MODE CONSTRUCTION AND THE DERIVATION OF KINETIC AND POTENTIAL ENERGY EXPANSION. Soerensen, Bent (Univ. of California, Berkeley). Nucl. Phys.; A142: 392-410(1970).

Truncation of the boson expansions earlier suggested for the description of collective excitations in doubly even nuclei make it important to start from the best possible boson representation. It is shown that the Tamm–Dancoff boson generally offers a better starting point than does the random phase boson. This is in particular true if the RPA boson is imaginary, which is shown in contrast two earlier assumptions to be the case for a majority of quadrupole-vibrating nuclei. In order to follow the quadrupole phase transition in the boson model the Hamiltonian is carried from the boson form into an expansion in terms of Hermitean variables specifying the mass quadrupole moment and its conjugate momentum. (auth)

26686 AN APPROXIMATION SCHEME FOR CONTINUUM SHELL-MODEL CALCULATIONS. Romo, William (Argonne National Lab., Ill.). Nucl. Phys.; A142: 300-20(1970).

In an earlier article a generalization of the MacDonald projected T-matrix theory as a basis for nuclear-scattering calculations was proposed. The formalism is slightly modified and it is shown that a calculational scheme based on the modified formalism gives substantially better results than one based on the unmodified formalism. (auth)

26687 THE STRUCTURE OF OPEN-SHELL NUCLEI IN THE PAIRING MODEL. Negele, J. W. (Cornell Univ., Ithaca, N. Y.). Nucl. Phys.; A142: 225-37(1970).

The possibility of understanding the ground states of even open-shell nuclei in terms of the self-consistent structure of neighboring closed shell nuclei and matrix elements of a realistic nucleon-nucleon interacting using the pairing model is explored. The average strength of the pairing matrix elements is shown to arise solely from the even partial waves of the two-body interaction and to be simply understood in terms of wave function overlap. Schematic calculations are presented which indicate the qualitative effects of shell spacing and the strength of the pairing matrix elements, and realistic calculations are reported for neutron shells in the ^{40}Ca, ^{90}Zr, ^{140}Ce and ^{208}Pb regions. (auth)

26688 SU_3 WIGNER COEFFICIENTS IN ANGULAR MOMENTUM SPACE. II. SEPARATION OF TWO sd-SHELL PARTICLES. Iosifescu, M.; Stancu, F. (Inst. for Atomic Physics, Bucharest). Nucl. Phys., A142: 481-7(1970).

The SU_3 Wigner coefficients in a basis of given angular momentum for the decoupling $(\lambda\mu) = (\lambda_1\mu_1) \times (\lambda_2\mu_2)$ with $\mu = 0.1$ and $(\lambda_2\mu_2) = (40),(21)$ were calculated. These coefficients may be used in the separation of two particles from a state of the $(sd)''$configuration labelled by the SU_3 scheme. (auth)

26689 SYSTEMATICS OF E_2 TRANSITIONS FROM 4^+ TO 2^+ STATE IN EVEN–EVEN DEFORMED NUCLEI. Rajput, M. S. (Aligarh Muslim Univ., Egypt). Nuovo Cim.; 66A: 343-8(21 Mar 1970).

E_2-transition probabilities for $4^+ \rightarrow 2^+$ transitions were calculated in some even-even nuclei using Davydov and Rostovsky formalism. The predictions of this model were compared with the experimental data. From this comparison it was found that the DR estimates are quite close to the experimental rates. The variations of the ratios $B(E_2)_{exp}/B(E_2)_{DR}$ and $B(E_2)_{exp}/B(E_2)_{SP}$ with nonaxiality parameter "γ_0" were studied. The factor $B(E_2)_{exp}/B(E_2)_{SP}$ decreases with the increase in the value of nonaxiality parameters, whereas the factor $B(E_2)_{exp}/B(E_2)_{DR}$ shows a slightly increasing trend. (auth)

REACTOR TECHNOLOGY

Commercial Power Reactors

Refer also to abstract 26755.

26690 (SwRI-1228-P-12-1) METALLURGICAL INVESTIGATION OF CRACKING IN LACBWR FEEDWATER-INLET-NOZZLE "SAFE-ENDS." Final Report. Burghard, H. C. Jr.; Lyle, Fred F. Jr. (Southwest Research Inst., San Antonio, Tex.). 16 Mar 1970. Contract AT(11-1)-1228. 70p. Dep. CFSTI.

An investigation of four sensitized stainless steel "safe-ends" removed from the feedwater nozzles which were welded to one of the recirculating headers of the LaCrosse Boiling Water Reactor is presented. Visual and metallographic examinations revealed extensive intergranular cracking in the Type 304 stainless steel "safe-ends" of two of the nozzles. Cracking was most severe in a crevice area formed by the "safe-end" and a thermal sleeve welded to it; however, cracking was also found outside the crevice area. Etch tests and accelerated corrosion tests established a strong correlation between the cracking and severe sensitization of the "safe-ends" which resulted from furnace stress-relieving the header. (8 references). (auth)

26691 (WCAP-6088) YANKEE CORE EVALUATION PROGRAM. Summary Report. Suda, A. P.; Chajson, L.; O'Boyle, M. J. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). Aug 1969. Contract AT(30-1)-3017. 75p. Dep. CFSTI.

The work performed under the Yankee Core Evaluation Program, the most comprehensive and thorough post-irradiation program ever performed on a spent commercial power-reactor core, is summarized. The specialized equipment and procedures used to ship, examine, and analyze the irradiated Yankee fuel are described. The chemical, metallurgical, engineering, and physics evaluations of the Yankee fuel and cladding are discussed, and the major results of these evaluations are presented. 22 references. (auth)

26692 DEVELOPMENT OF NUCLEAR PROGRAMS IN 1969. Com. Naz. Energ. Nucl., Notiz.; 16: No. 2, 63-5(Feb 1970). (In Italian).

Considerations concerning the nuclear power programs at the end of 1969 are reviewed. (auth)

26693 NUCLEAR ENERGY IN THE WORLD AT THE END OF 1969. Oliva, Domenico. Com. Naz. Energ. Nucl., Notiz.; 16: No. 2, 29-62(Feb 1970). (In Italian).

A review of the nuclear power plants in the world at the end of 1969 is presented with considerations concerning the prospects of the various plant types. (auth)

26694 NUCLEAR POWER PLANT FROM THE USER'S POINT OF VIEW. Numminen, Kalevi (Imatran Voima Oy, Helsinki). Ekono; No. 122, 51-64(1969). (In Finnish and Swedish).

Both the internal and external behavior of a power plant are considered. It is concluded that reliability is one of the most significant features, and that in a small country like Finland it is important to investigate closely how to connect a nuclear power plant with the existing state network. (Finland)

26695 EXPERIMENTAL AND THEORETICAL STRESS ANALYSIS OF PERFORATED BOTTOM MODELS OF THE DODEWAARD REACTOR VESSEL. Broekhoven, M. J. G. (Univ. of Tech., Delft, Netherlands). pp 317-33 of Pressure Vessel Technology. Pt. I. New York; American Society of Mechanical Engineers (1969).

From 1st International Conference on Pressure Vessel Technology, Delft, Netherlands. See CONF-690906(Pt.1).

The test procedures and the results of extensive experimental investigations on the reinforced spherical bottom of the Dodewaard reactor vessel, loaded by internal pressure and simulated scram reactions, are discussed. The bottom contains 37 parallel internal stub tubes with control-rod penetrations in a square pattern. The results of strain-gauge measurements on a scale 1:4 steel model and of measurements on two scale 1:10 three-dimensional photoelastic models are compared with results from strain-gauge measurements on the real vessel and with the results of an advanced computation method. Semiempirical conversion factors were determined representing the relationship among peak stresses at varying reinforced wall thickness. The experimental results show good agreement; differences can be explained fairly well by the influence of various factors, particularly the shape of the weld at the root of the stub tubes where a high, local peak stress occurs. The theoretical results show moderate agreement with the experimental results for some areas, and when properly interpreted; the maximum stresses have no senseful significance. Measurements under simulated scram loading yielded data about the interaction among the stub tubes; the absolute level of the stresses resulting from this type of loading was found to be insignificant. (auth)

26696 INSPECTION TECHNIQUE BY ELECTRIC-RESISTANCE PROBE METHOD ON A NUCLEAR REACTOR VESSEL. Yamaguchi, T. (Mitsubishi Heavy Industries, Ltd., Kobe, Japan); Fukue, J.; Takada, M.; Fujimura, T.; Hashimoto, T. pp 959-75 of Pressure Vessel Technology. Pt. II. New York; American Society of Mechanical Engineers (1969).

From 1st International Conference on Pressure Vessel Technology, Delft, Netherlands. See CONF-690906(Pt.2).

The principle, construction, and techniques of the electric-resistance probe method for inspecting a nuclear reactor pressure vessel are described. The techniques were applied to inspect the JPDR pressure vessel in 1968. As the results of the inspection, a few cracks were found and the maximum depths were defined as less than 3 mm. These results showed that the electric-resistance probe method was useful on in-service inspection of pressure vessels, and it was considered to be most promising for future inspections. (auth)

26697 POSTOPERATION INSPECTION ON JPDR PRESSURE VESSEL IN 1968. Suguri, S.; Miida, J.; Okuma, A.; Adachi, M.; Sasaki, S.; Furamura, Y.; Kawasaki, M. (Japan Atomic Energy Research Inst., Tokai). pp 977-86 of Pressure Vessel Technology. Pt. II. New York; American Society of Mechanical Engineers (1969).

From 1st International Conference on Pressure Vessel Technology, Delft, Netherlands. See CONF-690906(Pt.2).

The methods and the results of the inspection on the Japan Power Demonstration Reactor (JPDR) pressure vessel in 1968 are described. The inner surface of the bottom head, the vessel side wall, and the areas around the forced-circulation nozzles were inspected with the borescope, the resistance-probe system, the ultrasonic testing apparatus, and the dye-penetrant system. As a result of these inspections, some cracklike flaws were detected on several areas of the vessel cladding. However, it was concluded that these flaws were not so deep as to reach to the interface between base metal and clad. (auth)

26698 PERIODIC INSPECTION OF OSKARSHAMNSVERKET REACTOR VESSEL. Ahlberg, G. (Tekniska Rontgencentralen AB, Stockholm); Lautzenheiser, C.; Sandberg, O. pp 1033-48 of Pressure Vessel Technology. Pt. II. New York; American Society of Mechanical Engineers (1969).

From 1st International Conference on Pressure Vessel Technology, Delft, Netherlands. See CONF-690906(Pt.2).

The Oskarshamnsverket is a boiling-water system operating at 70-bars pressure and with an output of 400 MW(e). The system was designed and constructed by ASEA of Sweden on a turnkey basis. Early in the design phases, efforts to formulate a periodic inspection program were initiated. This program was based on the design analysis and utilized ultrasonic information generated during fabrication of the vessel. Problems of access for inspection became apparent, and ASEA made changes to allow for inspection of selected points. Equipment was designed to perform an ultrasonic inspection of the vessel shell, including the welds, the steam outlet nozzles, the recirculation nozzles, and the studs. Equipment was also designed to maneuver the ultrasonic apparatus and a remote television camera within the vessel. All of the equipment was designed for precise positioning and repeatability so as to reproduce accurately the initial inspection during future inspections. The overall inspection program and equipment included a data acquisition system to accumulate information relating inspection position to ultrasonic indications. A simulated inspection of the reactor is to be made using the equipment to determine access and operation problems. The final data generated will be a "fingerprint" inspection of the reactor pressure vessel for use as a reference basis for future inspections. (auth)

26699 EVALUATION OF PRINCIPAL FACTORS CONDITIONING THE QUALITY OF MATERIAL FOR PRESSURE VESSEL OF FIRST CZECHOSLOVAK NUCLEAR POWER PLANT. Becka, J.; Indra, J.; Prepechal, J. (SKODA Works, Pilsen, Czech.). pp 1065-81 of Pressure Vessel Technology. Pt. II. New York; American Society of Mechanical Engineers (1969).

From 1st International Conference on Pressure Vessel Technology, Delft, Netherlands. See CONF-690906(Pt.2).

An outline of the production-technology concept used for the pressure vessel of the first Czechoslovak nuclear power plant is presented. Based on an analysis of the results derived either from acceptance and complementary tests of rough forgings, plates, segments, and weldments or from additional development and research works, it evaluates the influence of the main factors determining the quality of the basic material and welds for this pressure vessel. Similar techniques can be applied to production of site-fabricated pressure vessels of large dimensions. (auth)

26700 CHARACTERISTICS OF CRACK PROPAGATION IN OVERLAID NOZZLES OF A NUCLEAR REACTOR. Fujimura, T. (Japan Atomic Energy Research Inst., Tokai); Miyazono, S.; Ueda, S.; Iwamoto, K.; Ueda, T. pp 1213-20 of Pressure Vessel Technology. Pt. II. New York; American Society of Mechanical Engineers (1969).

From 1st International Conference on Pressure Vessel Technology, Delft, Netherlands. See CONF-690906(Pt.2).

The Japan Power Demonstration Reactor (JPDR) is a nuclear power reactor of the boiling-water type and has operated for about 10,000 h since 1963. At the second periodic inspection of this reactor in 1966, a number of hair cracks were detected in the austenitic stainless-steel weld overlay inside the top head of the pressure vessel. The principal concern in continuing the operation of JPDR is the probability of the occurrence of similar cracking in other regions, where higher stresses are expected. These highly stressed regions are in the nozzle junctions. The Japan Atomic Energy Research Institute (JAERI) proposed the following program to assess the structural safety of the JPDR pressure vessel: (1) studies of crack propagation under the static and cyclic loading and (2) studies of the fracture behavior of pressure vessel models under cyclic pressure loading. Based upon preliminary results of the test program mentioned above, JAERI concludes at present that the JPDR pressure vessel will suffer no risk of catastrophic fracture for at least the next five years of the reactor operation. (auth)

26701 PLANNING FOR UNIT 1 OF THE TAKAHAMA NUCLEAR POWER STATION OF KANSAI POWER COMPANY. Okano, Shigeo (Kansai Electric Power Co., Osaka). Denki Kyokai Zasshi; No. 552, 717-24(Oct 1969). (In Japanese).

The power plant site in Takahama, Fukui Prefecture, was decided upon in December 1966. The reactor plant is a PWR with electric output of 826 MW. The reactor plant, including steam generators, will be made by Westinghouse Electric Corp., and the turbogenerator by Mitsubishi Atomic Power Industry, Inc. The construction of the Takahama power station is discussed; the site, including its acquisition, geological survey, and site preparation is described; and the reactor plant and facilities and the construction schedule are outlined. (NSA of Japan)

Operation and Economics

26702 (DOCKET-50219-72) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 1. Report in Support of Operation at 1690 MWt. Preliminary Safety Analysis Report, Amendment 55. (Jersey Central Power and Light Co., Morristown, N. J.). 5 May 1970. 83p. Dep. CFSTI.

26703 (GA-9898) 40-MW(E) PROTOTYPE HIGH-TEMPERATURE GAS-COOLED REACTOR POSTCONSTRUCTION RESEARCH AND DEVELOPMENT PROGRAM. Quarterly Progress Report for the Period Ending January 31, 1970. (Gulf General Atomic, Inc., San Diego, Calif.). 27 Feb 1970. Contract AT(04-3)-314. 21p. Dep. CFSTI.

Maintenance and core inspection activities performed during November 1969 to January 1970 are described. Fast neutron effects on core materials and fuel elements are analyzed. (D.C.C.)

26704 (TID-25401) GUNDREMMINGEN NUCLEAR POWER PLANT. Monthly Report, February 1970. (Kernkraftwerk RWE-Bayernwerk G.m.b.H., Gundremmingen (West Germany)). 9 Mar 1970. 45p. (In German). Dep. CFSTI.

On 22 February 1970 load was cut to 70 MW in order to carry out necessary repeat tests, change the control rod extraction sequence, and secure a torn bearing mounting on the feed water line. All the tests were satisfactory, and the rod scram times and the closing times of the steam line penetration valves were also within the permissible limits. With the drop in primary steam flow to 100 t/h the maximum local dose rate measured in the vicinity of the bearing mounting fell from 800 to 50 mrem/h, and the radiation burden for all persons engaged on the repair work was therefore less than 100 mrem. Only negligible changes took place in the exhaust gas activity during the reporting period. (auth)

26705 METHODS FOR THE ANALYSIS OF THE RENTABILITY OF NUCLEAR POWER PLANTS AND THEIR APPLICATION IN YUGOSLAVIA. Mojovic, Ljumbomir. Nukl. Energ.; 5: No. 6, 1-8(1968-9). (In Serbo-Croatian).

The economic factors of interest for the assessment of the rentability of nuclear power plants are being considered. The method of the integral annual costs used in Yugoslavia for the economic analysis of power plants is here applied to nuclear power plants, paying due regard to the current regulations and recommendations for such analyses. The methods and criteria for evaluating the rentability of projects and their intercomparison from the point of view of national economy are presented. A discussion follows on the feasibility of certain methods and criteria. (5 references) (auth)

26706 CHARTING THE STARTUP OF A NUCLEAR PLANT. Brugge, R. O.; Hoyt, Harlan H. Power; 114: No. 5, 25-9(May 1970).

The startup program for the Dresden Power Reactor Unit 2 is described. Testing procedures and requirements are outlined. (D.C.C.)

Safety and Siting

Refer also to abstract 25143.

26707 (BNL-14641) NUCLIDES OF CONCERN IN THE ENVIRONMENTAL ASPECTS OF NUCLEAR POWER OPERATIONS. Hull, Andrew P. (Brookhaven National Lab., Upton, N. Y.). [1969]. 7p. (CONF-700408-1). Dep. CFSTI.

From 2nd Conference on Radiation and Man's Environment, Buck Hill Falls, Pa.

The risks of nuclear power plants are considered in the context of the alternate choices in the generation of electricity. Particular emphasis is placed on the hazards of radionuclides such as tritium, ^{131}I, and the noble gases which are routinely emitted in small amounts by power reactors. The quantities involved, their hazards, and some basis for comparing these emissions with those from fossil fueled plants are discussed. The waste heat released by nuclear and conventional steam power plants is compared. It is concluded that nuclear plants offer far less threat to the environment than alleged by most nuclear power opponents and that nuclear plant development is proceeding with the public safety and welfare as a prime consideration. 15 references. (H.D.R.)

26708 (BRH/DER-70-1) RADIOLOGICAL SURVEILLANCE STUDIES AT A BOILING WATER NUCLEAR POWER REACTOR. Kahn, Bernd; Blanchard, Richard L.; Krieger, Herman L.; Kolde, Harry E.; Smith, David B.; Martin, Alex; Gold, Seymour; Averett, William J.; Brinck, William L.; Karches, Gerald J. (Bureau of Radiological Health, Rockville, Md. Div. of Environmental Radiation). Mar 1970. 117p. CFSTI.

Procedures and standards for radiological surveillance of Dresden Power Reactor Unit 1 are presented. Topics discussed include: radionuclides in liquids on site; radionuclides in liquid waste effluents; radionuclides released from stack; radionuclides in environmental air; radionuclides in surface water; and radionuclides in terrestrial environment. (45 references) (D.C.C.)

26709 (CONF-690952) PROCEEDINGS OF NUCLEAR POWER AND THE ENVIRONMENT, UNIVERSITY OF VERMONT, BURLINGTON, SEPTEMBER 11, 1969. (Vermont Univ., Burlington). 191p. GPO $0.75.

Possible radiation hazards and thermal effluent effects on environment are analyzed as pertaining to power reactor development in the U. S. Question and answer sessions are included. (D.C.C.)

26710 (DOCKET-1155-33) LA CROSSE BOILING WATER REACTOR. Fuel Pin Bowing Study. (Dairyland Power Cooperative, La Crosse, Wis.). 24 Apr 1970. 43p. (DPC-851-7). Dep. CFSTI.

26711 (DOCKET-1155-34) LA CROSSE BOILING WATER REACTOR. Reference Control Rod Program and Fuel Assembly Reloading Pattern. Supplement. (Nuclear Associates International Corp., Rockville, Md.). 10 Apr 1970. 43p. (NAI-70-30). Dep. CFSTI.

For Allis-Chalmers Mfg. Co., Atomic Energy Div., Bethesda, Md.

26712 (DOCKET-50029-116) YANKEE NUCLEAR POWER STATION. Vapor Container Class A Test Results. (Yankee Atomic Electric Co., Rowe, Mass.). Aug 1969. 16p. (YAEC-1038). Dep. CFSTI.

26713 (DOCKET-50146-54) SAXTON REACTOR. Operator Retraining Program. (Saxton Nuclear Experimental Corp., Pa.). 30 Apr 1970. 4p. Dep. CFSTI.

26714 (DOCKET-50146-55) SAXTON REACTOR. License No. DPR-4. Technical Specifications Change Request No. 39. (Saxton Nuclear Experimental Corp., Pa.). 12 May 1970. 5p. Dep. CFSTI.

Modifications for Zircaloy-4 clad test fuel elements are presented. Spacing pellets of Al_2O_3 are inserted among UO_2 fuel pellets. (D.C.C.)

26715 (DOCKET-50171-48) PEACH BOTTOM ATOMIC POWER STATION, UNIT 1. Request for Authorization of Facility Change and Associated Technical Specification Change (No. 14). (Philadelphia Electric Co., Pa.). 23 Apr 1970. 246p. Dep. CFSTI.

Technical specification changes in fuel element design and testing programs are presented. (D.C.C.)

26716 (DOCKET-50213-39) CONNECTICUT YANKEE ATOMIC POWER PLANT. License No. DPR-14: Technical Specifications Change No. 13. (Division of Reactor Licensing (AEC), Washington, D. C.). 29 Apr 1970. 3p. Dep. CFSTI.

Testing procedures for the containment building air filtration system are presented. (D.C.C.)

26717 (DOCKET-50219-71) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 1. Preliminary Safety Analysis Report, Amendment 54. (Jersey Central Power and Light Co., Morristown, N. J.). 5 May 1970. 3p. Dep. CFSTI.

Vibration test results for pressure vessel internals are presented. (D.C.C.)

26718 (DOCKET-50220-40) NINE MILE POINT NUCLEAR STATION, UNIT NO. 1. Reactor Primary System Investigation. (Niagara Mohawk Power Corp., Syracuse, N. Y.). 1 May 1970. 234p. Dep. CFSTI.

26719 (DOCKET-50220-41) NINE MILE POINT NUCLEAR STATION. Program for Restoration to Service: Based on Reports of Primary System Investigation. (Niagara Mohawk Power Corp., Syracuse, N. Y.). 11 May 1970. 42p. Dep. CFSTI.

Modifications and replacement requirements are described for sensitized stainless steel cooling system components. All components are attached to the pressure vessel. (D.C.C.)

26720 (DOCKET-50220-42) NINE MILE POINT NUCLEAR STATION. Reactor Primary System Investigation. Report No. 2. (Niagara Mohawk Power Corp., Syracuse, N. Y.). 11 May 1970. 24p. Dep. CFSTI.

Inspection procedures and results for feedwater inlet nozzles are presented. (D.C.C.)

26721 (DOCKET-50247-19) INDIAN POINT NUCLEAR GENERATING UNIT NO. 2. Preliminary Safety Analysis Report, [Amendment 2]. (Consolidated Edison Co. of New York, Inc., New York). 1 Jun 1966. 94p. Dep. CFSTI.

Revised information concerning the emergency core cooling system is presented. Stress limits for the primary cooling system and containment structures are included. (D.C.C.)

26722 (DOCKET-50249-34) DRESDEN NUCLEAR POWER STATION, UNIT 3. Preliminary Safety Analysis Report, Amendment 22. (Commonwealth Edison Co., Chicago, Ill.). 7 May 1970. 26p. Dep. CFSTI.

The specific ACRS letter items concerning Dresden Unit 3 which have been received are summarized. Licensing items which have been added to Units 2 and 3 are reviewed. The Unit 3 reactor vessel nozzle safe end replacement activities are described, and the addition of a cooling pond is discussed. Unit 3 technical specifications are presented. (H.D.R.)

26723 (DOCKET-50250-25) TURKEY POINT PLANT, UNITS NO. 3 AND NO. 4. Preliminary Safety Analysis Report, [Amendment 19], Suppl. 19. (Florida Power and Light Co.). 1 May 1970. 505p. (DOCKET-50251-23). Dep. CFSTI.

Additional information concerning the Final Safety Analysis Report for Turkey Point Units 3 and 4 is presented. Responses to questions are included on the plant: site and environment, reactor, reactor coolant system, structures, engineered safety features, instrumentation and control, electrical supply, auxiliary systems, waste disposal and radiation protection, conduct of operations, initial tests, and safety analysis. (H.D.R.)

26724 (DOCKET-50261-28) H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2. Preliminary Safety Analysis Report, Amendment 21 (Final Safety Analysis Report, Amendment 12). (Carolina Power and Light Co., Raleigh, N. C.). 8 May 1970. 39p. Dep. CFSTI.

Qualifications for startup operation personnel are presented. (D.C.C.)

26725 (DOCKET-50263-37) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Preliminary Safety Analysis Report, Amendment 26. (Northern States Power Co., Minneapolis, Minn.). 7 May 1970. 6p. Dep. CFSTI.

Modifications and replacement requirements are described for sensitized stainless steel cooling system components. All components are attached to the pressure vessel. (D.C.C.)

26726 (DOCKET-50266-20) POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 7. (Wisconsin Electric Power Co., Milwaukee. Wisconsin Michigan Power Co., Appleton, Wis.). 27 Apr 1970. 250p. (DOCKET-50301-17). Dep. CFSTI.

Revised information on containment systems is presented. Safety limits for reactor operation are described. Minimum criticality requirements are analyzed. Stress limits for piping systems are presented. Instrumentation and auxiliary power systems are described. Meteorological data for the reactor site are included. Operating procedures and personnel responsibilities are reviewed. (D.C.C.)

26727 (DOCKET-50271-21) VERMONT YANKEE NUCLEAR POWER STATION. Preliminary Safety Analysis Report, Amendment 12. (Vermont Yankee Nuclear Power Corp., Rutland). 22 Apr 1970. 9p. Dep. CFSTI.

Additional information concerning the effectiveness of the emergency core cooling system is presented. The effects of containment structure inerting on the performance of the emergency core cooling system are analyzed. (D.C.C.)

26728 (DOCKET-50302-13) CRYSTAL RIVER NUCLEAR GENERATING PLANT, UNIT 3. Preliminary Safety Analysis Report, Amendment 9. (Florida Power Corp., St. Petersburg). 27 Apr 1970. 66p. Dep. CFSTI.

Financial data on the owners of the Crystal River Power Reactor Unit 3 are given in support of the application for construction permit and operating license. The 1969 Annual Report for the Florida Power Corporation and the 1959 to 1969 Statistical Report for the Florida Power Corporation are included. (D.C.C.)

26729 (DOCKET-50329-13) MIDLAND PLANT, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 11. (Consumers Power Co., Jackson, Mich.). 1 May 1970. 31p. (DOCKET-50330-13). Dep. CFSTI.

Additional information concerning geological characteristics of the site is presented. Reactor safeguard systems are described. Chlorine storage hazards for the reactor are analyzed. Radionuclide release limits for the environment are reviewed. (D.C.C.)

26730 (DOCKET-50334-22) BEAVER VALLEY POWER STATION. Safety Evaluation. (Division of Reactor Licensing (AEC), Washington, D. C.). 24 Apr 1970. 99p. Dep. CFSTI.

26731 (DOCKET-50336-12) MILLSTONE NUCLEAR POWER STATION, UNIT 2. Preliminary Safety Analysis Report, Amendment 8. (Connecticut Light and Power Co., Hartford. Hartford Electric Light Co., Conn. Western Massachusetts Electric Co., Greenfield. Millstone Point Co., Wethersfield, Conn.). 5 May 1970. 27p. Dep. CFSTI.

Containment structure ventilation systems are described. Engineered safeguards for power loss conditions are reviewed. Radioisotope concentrations in reactor systems are analyzed. (D.C.C.)

26732 (DOCKET-50338-16) NORTH ANNA POWER STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 7. (Virginia Electric and Power Co., Richmond). 11 May 1970. 9p. (DOCKET-50339-16). Dep. CFSTI.

Revised information concerning fuel handling accident conditions is presented. (D.C.C.)

26733 (DOCKET-50341-9) ENRICO FERMI ATOMIC POWER PLANT, UNIT 2. Preliminary Safety Analysis Report, Amendment 3. (Detroit Edison Co., Mich.). 11 May 1970. 467p. Dep. CFSTI.

Additional hydrological and meteorological data for the site are presented. Seismic stress analysis for reactor systems is included. Containment structure coatings are described. Containment structure penetrations are listed. Design parameters of fuel element assemblies are presented. Engineered safeguards and auxiliary power systems are described. Waste storage facilities radioactivity levels are listed. Quality assurance requirements for reactor components are described. (D.C.C.)

26734 (DOCKET-50344-9) TROJAN NUCLEAR PLANT. Preliminary Safety Analysis Report, Amendment 6. (Portland General Electric Co., Oreg.). 1 May 1970. 550p. Dep. CFSTI.

General plant layout drawings are included. Site geological and hydrological data are presented. Revised information is presented for auxiliary power systems, containment systems and structures, cooling system, emergency core cooling system, and engineered safeguards. (D.C.C.)

26735 (ORNL-TM-2900) AN INTERPRETIVE REVIEW OF SEISMIC DESIGN METHODS. (United Nuclear Corp., [Elmsford, N. Y.]). May 1970. Contract W-7405-eng-26; Subcontract 2933. 97p. Dep. CFSTI.

For Oak Ridge National Lab., Tenn.

The procedures and analytical methods most suited to a seismic design analysis of structures, with particular reference to Class I nuclear power systems, are presented. These procedures include the prediction and simulation of the earthquake forcing function, determination of the dynamic response of the system structural model, evaluation of structural components and a failure analysis. The deterministic approach to earthquake motion simulation is used although the probabilistic approach is recommended for future study and application. A linear elastic structural model formulated by either the lumped parameter or finite element method appears to be a practical choice to model the complicated structure of a nuclear reactor and its components. The modal analysis technique is recommended for computing both stationary and non-stationary dynamic responses. Numerical procedures applicable to digital computer programs are presented, and a survey of the available applicable digital computer programs to compute both the structural model and its dynamic response is recommended. 102 references. (auth)

26736 (ORNL-TM-2901) INTERACTION OF A SEISMIC DISTURBANCE WITH A REACTOR FACILITY. (United Nuclear Corp., [Elmsford, N. Y.]). May 1970. Contract W-7405-eng-26; Subcontract 2933. 73p. Dep. CFSTI.

For Oak Ridge National Lab., Tenn.

The influence of structure-media interaction effects upon the response of a reactor facility was investigated. An approximate interaction law was used to determine the response of the BONUS facility to the Golden Gate earthquake. A computer code, SIM, incorporating this interaction law was used to compute the horizontal, vertical, and rotational response of the BONUS facility. The motion of the center of gravity of BONUS was found to be less than that of the free field and the attenuation was found to vary inversely with the soil stiffness. The rotation of the facility was found to have a large influence on the motion of points far removed from the center of gravity. At these locations, the motion in the facility was more severe than the free-field disturbance. Based on these results, the format of a design procedure was outlined. Shock spectra representing the motion of both the free field and the center of gravity of the facility were determined. Attenuation factors were computed as the ratio of the two spectra. These attenuation factors then could be applied to any given spectra representing a free-field disturbance to determine the spectra for the motion of the center of gravity of the facility. Finally, it appears that simple relationships which give an approximate estimate of the rotation of the facility may be derived. 12 references. (auth)

26737 HYDRO-ELECTRIC GENERATOR AS A SOURCE OF RAPID STAND-BY POWER FOR HOUSE CONSUMPTION NEEDS OF ATOMIC POWER PLANTS. Paulicka, Ivan; Jakubik, Alojz. Energetika; 20: 57-9(Feb 1970). (In Czech).

Adapting the type HRO VII governor of the Kaplan turbines at the Madunice hydroelectric power station to meet the requirements of rapid standby service for the Bohunice Power Reactor is described. A review is presented of the standby tests carried out on the governor to prove its suitability for the desired mode of operation. (auth)

Power Reactor Development

26738 (EURFNR-714) FAST BREEDER DEVELOPMENT; CONTRIBUTIONS TO THE 1969 REACTOR CONFERENCE OF THE DEUTSCHE ATOMFORUM HELD IN FRANKFURT/MAIN FROM 15-18 APRIL 1969. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Translation of report KFK-964. 100p. Dep. CFSTI.

Work Performed under United States-Euratom Fast Reactor Exchange Program.

Topics related to development programs for fast breeder reactors are discussed. Separate abstracts for each paper have been prepared from the original language and appear in NSA Vol. 24 under the following abstract numbers: 18615, 18616, 18632, 18633, 18649, 18650, 18651, 18652, 18653, 18673, and 18687. (D.C.C.)

26739 (NP-18211) ELEVENTH ACTIVITY REPORT, PARIS, DECEMBER 1969. (European Nuclear Energy Agency, Paris (France)). 93p. Dep. CFSTI (U. S. Sales Only). OECD.

Topics discussed include: Joint Undertakings and Common Services; Nuclear Power; Scientific and Technical Cooperation; Health and Safety; and Legal Affairs. (D.C.C.)

26740 (ORNL-TM-2974) PLANS FOR POST-OPERATION EXAMINATION OF THE MOLTEN-SALT REACTOR EXPERIMENT. Haubenreich, P. N.; Richardson, M. (Oak Ridge National Lab., Tenn.). 7 Apr 1970. 30p. Dep. CFSTI.

In December 1969, after more than 4 successful years, the nuclear operation of the MSRE was concluded and the plant was placed in standby. Work planned for early in FY-1971 includes removal of some core graphite; viewing inside the reactor vessel and inside the fuel-pump bowl; inspection of portions of the salt piping, the offgas charcoal bed, the coolant salt pump, and the control rods; and testing the coolant salt flowmeter. Procedures and tools are available for some jobs; for others, they are currently being developed. (auth)

26741 REVIEW OF THE WORLD'S NUCLEAR POWER SITUATION. Vapaavuori, Olavi (Ekono, Helsinki). Ekono; No. 122, 26-50(1969). (In Finnish and Swedish).

On the basis of sixteen references sources, economics reactor type, and fuel resource problems are examined. (Finland)

Kinetics and Dynamics

Refer also to abstract 26830.

26742 (GA-9658(Vol.1)) LATTICE PHYSICS STUDIES. FINAL REPORT, VOLUME I. Trimble, G. D.; Gozani, T.; Neill, J. M.; d'Oultremont, P.; Preskitt, C. A. (Gulf General Atomic, Inc., San Diego, Calif.). 31 Jul 1969. Contract AT(04-3)-167. 293p. (EURAEC-2131(Vol.1)). Dep. CFSTI.

Work Performed under United States-Euratom Joint Research and Development Program.

ALUMINUM ALLOYS AND SYSTEMS—Al-Pu, neutron spectra in water moderated rod type fuel elements of, analysis of thermal, (E/T)

ALUMINUM OXIDES—Al_2O_3-Er_2O_3, neutron spectra in simulated fuel elements of, analysis of epithermal and thermal, (E/T)

ERBIUM NITRATES—neutron spectra in aqueous, analysis of epithermal and thermal, (E/T)

ERBIUM OXIDES—Al_2O_3-Er_2O_3, neutron spectra in simulated fuel elements of, analysis of epithermal and thermal, (E/T)

NEUTRON SOURCES—design parameters of Lattice Experimental Facility

NEUTRONS, EPITHERMAL—spectra in simulated aluminum-plutonium alloy cylinder shaped fuel elements, (E/T)
—spectra in aluminum oxide (Al_2O_3)-erbium oxide (Er_2O_3) and aqueous erbium nitrate ($Er(NO_3)_3$), (E/T)

NEUTRONS, THERMAL—spectra in simulated aluminum-plutonium alloy cylinder shaped fuel elements, (E/T)
—spectra in aluminum oxide (Al_2O_3)-erbium oxide (Er_2O_3) and aqueous erbium nitrate ($Er(NO_3)_3$), (E/T)
—spectra in water moderated lattices of uranium rod type fuel elements, (E/T)
—spectra in water moderated lattices of aluminum-plutonium alloy rod type fuel elements, (E/T)

PLUTONIUM ALLOYS AND SYSTEMS—Al-Pu, neutron spectra in water moderated rod type fuel elements of, analysis of thermal, (E/T)

REACTOR FUEL ELEMENTS—neutron spectra in simulated aluminum-plutonium alloy cylinder shaped, analysis of epithermal and thermal, (E/T)
—neutron spectra in water moderated uranium rod type, analysis of thermal, (E/T)
—neutron spectra in water moderated aluminum-plutonium alloy rod type, analysis of thermal, (E/T)

URANIUM—neutron spectra in water moderated rod type fuel elements of, analysis of thermal, (E/T) (D.C.C.)

26743 (GA-9658(Vol.2)) LATTICE PHYSICS STUDIES. FINAL REPORT, VOLUME II. Neill, J. M.; Trimble, G. D.; Gozani, T.; d'Oultremont, P.; Preskitt, C. A. (Gulf General Atomic, Inc., San Diego, Calif.). 31 Jul 1969. Contract AT-(04-3)-167. 51p. (EURAEC-2131(Vol.2)). Dep. CFSTI.

Work Performed under United States–Euratom Joint Research and Development Program.

GLOVE BOXES—design parameters of plutonium nitrate shielded container
PLUTONIUM NITRATES—criticality calculations for shielded containers of
SHIELDED CONTAINERS—design parameters of plutonium nitrate glove box (D.C.C.)

Control Systems

Refer also to abstract 25323.

26744 (CONF-680666–1) RELIABILITY CONSIDERATIONS FOR ELECTRO-MECHANICAL AND HYDRAULIC CONTROL ROD DRIVE SYSTEMS. Ehrentreich, J.; Maurer, H. (European Atomic Energy Community). [1968]. 57p. Dep. CFSTI (U. S. Sales Only).

From Meeting on the Reliability of Electrical Supply Systems and Related Electro-Mechanical Components for Nuclear Reactor Safety, Ispra, Italy.

In the design of control rod drives different principles are adopted by the various suppliers. The systems used with water-cooled power reactors are described comparatively and analyzed with respect to their reliability for normal and scram operation. The following points are considered: (1) Drawing up of system block diagrams as the basis for the reliability analysis for normal and scram operation. (2) Estimation of possible fault rates of system components on the basis of test and operational results. (3) Comparison of the analytically determined inherent system reliability with the operational system reliability of various control rod drives. (4) Reliability analysis of the complete control systems (total number of control and safety rods) on the basis of the analysis of the individual rod drives and critical comparison of the various design principles. (auth)

26745 (CONF-690951–1) RELIABILITY CONSIDERATIONS FOR MECHANICAL COMPONENTS OF CONTROL ROD DRIVE SYSTEMS OF GAS-COOLED POWER REACTORS OPERATED IN THE EUROPEAN COMMUNITY. Ehrentreich, J.; Maurer, H. (European Communities, Brussels (Belgium). Commission). [1969]. 48p. Dep. CFSTI (U. S. Sales Only).

From Meeting on the Reliability of Mechanical Components and Systems for Nuclear Reactor Safety, Riso, Denmark.

Different principles adopted by various suppliers of mechanical parts for control-rod drive systems in gas-cooled power reactors operated in the European Community are described on a comparative basis. The function of the different systems is demonstrated by reliability block diagrams and the reliability analysed for both normal and scram mode of operation. 10 references. (auth)

26746 NUCLEAR REACTORS. Wray, Dudley (to United Kingdom Atomic Energy Authority). British Patent 1,186,022. 2 Apr 1970. Filed 13 Mar 1967.

Reference is made to steam generating light water reactors having a positive void coefficient and to reactivity control of such reactors, and in particular to means for effecting rapid shutdown. In the system described means are provided, sensitive to a reactivity responsive control signal, for injecting additional water into the coolant, the temperature of this water being lower than the saturation temperature of the coolant. Injection of this water into the coolant causes steam in the coolant tubes to condense thus reducing voidage and reactivity. The rate of addition of water may be regulated so that reactivity is stabilized at a preselected value. The means for injecting the additional water may comprise a sparge pipe located within the nuclear fuel in the coolant tubes. (UK)

26747 OUTPUT CONTROL OF A BOILING-WATER REACTOR INSTALLATION FOR CURRENT AND PROCESS-STEAM GENERATION. Reinhardt, Alfred; Stephan, Wendel (AEG-Telefunken, Frankfurt am Main). At. Strom; 16: 33-7(Feb 1970). (In German).

The speed of load variation which can be achieved with a boiling-water reactor is demonstrated. The selection of the designs for the block-unit output regulation is shown to be justified; both the designs for a single-circuit installation and for a process-steam installation result from the same aim: favorable matching of all the components involved in the output regulation. (auth)

26748 RAPID SHUT-DOWN SYSTEM FOR WATER-COOLED NUCLEAR REACTORS. (to Licentia Patent-Verwaltungs GmbH). British Patent 1,190,169. 29 Apr, 1970. Priority date 25 Aug 1967, Germany.

REACTOR CONTROL ELEMENTS—drives for water cooled, description of hydraulic actuated shutdown
REACTORS, WATER-COOLED—control elements of, description of hydraulic actuated shutdown drives for (D.C.C.)

Shielding

Refer also to abstract 26804.

26749 GRAPHIC DETERMINATION OF THE PARAMETERS OF THE TEMPERATURE DISTRIBUTION IN THE CONCRETE OF THE REACTOR BIOLOGICAL SHIELD. Gavrilovic, Milan. Nukl. Energ.; 5: No. 6, 12-14(1968-9). (In Serbo-Croatian).

A practical engineering graphic procedure is presented for determining the parameters of the radial temperature field in the concrete of the biological reactor shield, cooled in two vertical concentric cylindrical surfaces (the first one is the inner surface of the concrete, the second one is inside the concrete itself). The procedure has been designed for the analysis of the power reactor shields and, because of their large sizes, it has been treated in plane geometry. The exact distribution of nuclear heating, in the radial direction, has been approximated by the simple exponential function. By comparison with the numerical calculations a very good concordance of results has been observed. (7 references) (auth)

Cooling Systems

Refer also to abstracts 25174, 25175, 25191, 25235, and 25342.

26750 (CEA-Bib-79(Add.1)) IN-SERVICE RUPTURE OF PIPES AND PRESSURE VESSELS OF NUCLEAR REACTORS. Le Levier, Marie-Genevieve (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Mar 1970. 91p. (In French). Dep. CFSTI (U. S. Sales Only).

This reviewed bibliography deals with 243 references selected from volumes 20, 21 and 22 of Nuclear Science Abstracts and corresponding to the period of July 1966 to December 1968. (auth) (France)

26751 (DUN-SA–118) ON-STREAM ANALYSIS AND CONTROL OF NUCLEAR REACTOR ATMOSPHERE IN WATER-COOLED GRAPHITE MODERATED REACTORS. Clement, T. M. (Douglas United Nuclear, Inc., Richland, Wash.). 20 Nov 1969. Contract AT(45-1)-1857. 11p. (CONF-700513–1). Dep. CFSTI.

From International Measurement Confederation Conference, Versailles, France.

A description of an inert cover-gas system for a water-cooled graphite-moderated reactor is presented. The control system for the cover-gas circuit is described. The inert gas system protects the graphite from oxidation, detects water leaks, and removes moisture when leaks do occur. Circuit diagrams for the inert gas system and control system are included. (D.C.C.)

26752 (GA–10073) FISSION PRODUCT TRANSPORT IN HTGR SYSTEMS: A SUMMARY. Vanslager, F. E.; Bell, W. E.; Sisman, O.; Morgan, M. T. (Gulf General Atomic, Inc., San Diego, Calif.). 22 Apr 1970. Contract AT(04-3)-167. 28p. (CONF-700401–1). Dep. CFSTI.

From Gas-Cooled Reactor Program Information Meeting, Oak Ridge, Tenn.

A brief summary of fission product transport in a gas-cooled reactor is presented. Analytical methods applicable to reactor situations are presented along with a variety of old and new experimental data to illustrate the calculational techniques. These methods indicate that the gaseous activity in a well-designed gas-cooled reactor system can be easily held to acceptable levels and will consist almost entirely of noble gases. Some plateout activity will result from these noble gas precursors as well as from the halogen precursors which are found to have release rates essentially equal to noble gases. The other fission products, provided normal precautions are taken, will not be released from the fuel elements in sufficient quantities to significantly increase the plateout levels above that resulting from these gaseous precursors. (19 references) (auth)

26753 SODIUM VAPOR DEPOSITION IN INERT ENCLOSURES. Sutherland, J. D.; Markley, R. A.; Mckinney, J. L. (Westinghouse Electric Corp., Madison, Pa.). J. Eng. Power; 92: 107-12(Apr 1970). (CONF-691114–2).

From 90th Annual Meeting on American Society of Mechanical Engineers, Los Angeles, Calif.

Sodium vapor deposition is acknowledged to be a potential problem in several activities associated with LMFBRs. Attempts were made to predict Na evaporation rates using the empirical expression $Nu = 0.643 (GrSc)^{0.25}$ developed for the evaporation of water. Small scale experiments were performed which indicate the general validity of this expression for Na evaporation. The experiments also demonstrated that deposition of Na within inert gas filled enclosures can be substantially reduced by circulating and filtering the atmosphere of the enclosure. 6 references. (auth)

26754 GAS COOLED NUCLEAR REACTORS. Robson, Arthur Gray (to Nuclear Power Group Ltd.). British Patent 1,186,622. 2 Apr 1970. Filed 7 Sep 1967.

In gas cooled graphite-moderated reactors for use at higher operating temperatures it is necessary to limit the temperature and temperature gradients in the graphite and one way of effecting this is by channeling of the coolant gas. In the system described the direction of gas flow is such that hot gas leaving the reactor core is collected at the lower end of or beneath the core, and the lower end of the core has a portion with interconnected passages forming a collecting chamber for gas coolant. The collecting chamber may be constituted by a layer of graphite blocks having portions of reduced cross section between their ends. The core and the collecting chamber may be supported by pillars on the pressure vessel floor, or may rest on the pressure vessel floor. Various alternative forms of coolant flow path are described in relation to different reactor types. (UK)

26755 INSTRUMENTATION FOR MEASURING THE ENERGY DISTRIBUTION IN THE REACTOR CORE. Vriese, A. Polytech. Tijdschr. Elektrotech. Elektron.; 23: 671-4(13 Sep 1968). (In Dutch).

The factors which affect the thermal load on reactor cores (particularly in boiling water reactors), such as critical heat flux, maximum fission material temperature and maximum steam volume percentage at the reactor core outlet are analyzed. The traversing in-core probe which is used in Dodewaard is described. (UKAEA Info. Bull.)

26756 IMPROVEMENT RELATING TO LIQUID METAL COOLED NUCLEAR REACTORS. Gatley, John Andrew; Taylor, Derek (to United Kingdom Atomic Energy Authority). British Patent 1,187,391. 8 Apr 1970. Filed 10 May 1966.

Reference is made to liquid metal cooled reactors of the "wet system" type, implying submergence of the primary coolant circuit including the core in a reservoir of coolant, with the primary circuit open to this reservoir. It is usual in upward flow reactors cooled by liquid metal for coolant which has passed through the primary circuit to be allowed to form a free surface exposed to a blanket gas. In this system described provision is made for distributing a flow of coolant taken from the reservoir into extended surface contact with the blanket gas, the main purpose being that this arrangement can be set in operation when heating of the coolant in the core tends to be excessive, condensing coolant vapor being released into the blanket gas and relieving undesirable pressure increase which could otherwise arise from accumulation of vapor. The arrangement is primarily a safety measure and is particularly applicable to fast reactors. Distribution of the reservoir coolant may be by spraying, and such devices as packed beds, stacked grids, etc., through which the reservoir coolant will come in contact with the blanket gas may be provided. (UK)

26757 IMPROVEMENTS IN OR RELATING TO GAS CIRCULATORY DRIVES FOR NUCLEAR REACTORS. Daniels, Geoffrey Henry (to Nuclear Power Group, Ltd.). British Patent 1,187,691. 15 Apr 1970. Filed 10 Jan 1968.

In the system described each circulator has a variable frequency ac motor drive connected under normal operating conditions to a mains supply or a locally generated supply, or to at least one auxiliary generator if the normal supply fails, the frequency of the auxiliary generator being automatically varied in response to change in circulator load. Each variable frequency auxiliary generator may be connectable to a group of motors and means provided for connecting each motor of the group in turn to the generator under predetermined operating conditions. Control means are provided which, on sensing a fault in the normal supply, disconnect all except one of the motors of the group from the normal supply, start up the auxiliary generator, and connect the one motor to the generator when the latter has reached a predetermined speed less than full speed. The control means further detects current flow from the generator and subsequently connects, if required, further motors of the group to the generator as determined by the sensed current flow. It may also be arranged that the one motor is connected to the generator when the latter has reached motor speed. An example is given of the system as applied to light circulators. (UK)

26758 SPATIAL TEMPERATURE DISTRIBUTION IN A CONCRETE VESSEL. Zdravkovic, Momcilo; Vlajic, Milorad. Nukl. Energ.; 5: No. 6, 26-9(1968-9). (In Serbo-Croatian).

An analytical model for the determination of the spatial temperature field caused by the working temperature and nuclear heating inside the reactor vessel has been constructed. The analytical model has been applied to the concept of a one-wall cold reactor vessel of prestressed concrete (500 MW BHWR). (15 references) (auth)

26759 ANALYSIS OF THE SENSITIVITY OF THE TEMPERATURE FIELD OF THE REACTOR VESSEL TO THE ALTERATION OF RELEVANT FIELD PARAMETERS. Vlajic, Milorad. Nukl. Energ.; 5: No. 6, 23-5(1968-9). (In Serbo-Croatian).

An analysis has been made of the sensitivity of the temperature field in the equatorial plane to the partial changes in some of the relevant parameters. This plane has been considered adiabatic. The results of the analysis, shown graphically, indicate to the following order of parameters by the degree of their effect upon the temperature field: geometry of the cooling system of the piping, temperature of the cooling water, coefficient of concrete conductivity, equivalent coefficient of the conductivity of isolation, thickness of the wall of the vessel, and temperature on the outer surface of the wall of the vessel. (2 references) (auth)

26760 DISTRIBUTION OF NUCLEAR HEATING IN THERMAL INSULATION AND THE CONCRETE REACTOR VESSEL. Gavrilovic, Milan. Nukl. Energ.; 5: No. 6, 20-2(1968-9). (In Serbo-Croatian).

The procedure for the calculation of the radial distribution of nuclear heating in the elements of the thermal insulation and in the concrete of the reactor vessel is presented. The procedure can be used also for the calculation of the distribution of nuclear heating, dose velocity and the flux of the gamma rays through the whole system of protection, but during its execution particular attention has been paid to the needs of the analyses of thermal insulation. In view of the very large sizes of the reactor of a OP-500 MW nuclear power plant, the problem has been solved in a one-dimensional system under the assumption of surface geometry. Use has been made of the method of accumulation factors with the Taylor approximation. (11 references) (auth)

26761 CONCEPTION OF A MODEL OF A PRESTRESSED CONCRETE REACTOR VESSEL. Stankovic, Caslav; Petrovic, Bosko. Nukl. Energ.; 5: No. 6, 9-11(1968-9). (In Serbo-Croatian).

A technical and economic comparison has been made of a prestressed concrete reactor vessel with one and two walls followed by a brief description of the possibilities for the construction of a hot vessel. The criteria for the choice of the reactor vessel model concept have been analysed. The conception has been adopted of a double-wall vessel which would be first tested as a warm and later as a hot vessel. (auth)

26762 BEHAVIOR OF CONCRETE REACTOR VESSELS AT ELEVATED TEMPERATURES AND DESIGN OF THE THERMAL SHIELD. Stankovic, Caslav. Nukl. Energ.; 5: No. 6, 16-19 (1968-9). (In Serbo-Croatian).

An analysis has been made of the characteristics of temperature stresses in concrete reactor vessels, and the results shown of an investigation into the behavior of concrete vessels at elevated temperatures: the mechanical and thermodynamical characteristics of the concrete, and the mechanical characteristics of steel for prestressing. The conclusions hint to a further possible development of these vessels. A brief review of a design for the thermal protection of a concrete reactor vessel for a 500 MW BHWR is presented. The problems of the deep cooling of the vessel are analyzed. (9 references) (auth)

26763 A SYSTEMATIC BOLT-TIGHTENING PROCEDURE FOR REACTOR VESSEL FLANGES. Van Campen, D. H. (Univ. of Tech., Delft, Netherlands). pp 131-41 of Pressure Vessel Technology. Pt. I. New York; American Society of Mechanical Engineers (1969).

From 1st International Conference on Pressure Vessel Technology, Delft, Netherlands. See CONF-690906(Pt.1).

A systematic, semiempirical procedure is proposed to tighten a bolted flange connection where the bolts are divided into groups and these groups are prestressed successively by hydraulic jacks. The only assumption made in this procedure and borne out by experimental evidence is the proportionality between the bolt force after prestressing and the jack pressure in the pressure area under consideration. Starting with an arbitrary tightening experiment (for example, the pressure test), it is possible to establish an accurate tightening procedure that results in nearly the same normal force in all the bolts. The experiments from which the results mentioned above were gleaned are described and discussed in some detail. (auth)

26764 COMPUTER PROGRAMS AND THEIR APPLICATION FOR TEMPERATURE AND STRESS ANALYSIS OF REACTOR PRESSURE VESSELS. Tarandi, T. (Vattenbyggnadsbyran, Stockholm). pp 203-11 of Pressure Vessel Technology. Pt. I. New York; American Society of Mechanical Engineers (1969).

From 1st International Conference on Pressure Vessel Technology, Delft, Netherlands. See CONF-690906(Pt.1).

Some computer programs and their application for the mechanical design of reactor vessels are described. The programs developed are for calculating temperature distribution in axisymmetric bodies, stresses in thin shells of revolution, and stress distribution in thick pressure vessels. 11 references. (auth)

26765 STATISTICAL INTERPRETATION OF CREEP DATA FOR THE EVALUATION OF DESIGN CRITERIA FOR REACTOR PRESSURE TUBES. Montagnani, M.; Putzeys, J. (EURATOM, Ispra, Italy). pp 839-43 of Pressure Vessel Technology. Pt. II. New York; American Society of Mechanical Engineers (1969).

From 1st International Conference on Pressure Vessel Technology, Delft, Netherlands. See CONF-690906(Pt.2).

In a heavy-water moderated and organic-cooled reactor, the allowable working stress for hot pressure tubes is based upon their creep behavior. It was established that creep tests performed on tensile specimens were not appropriate to study creep of tubes, so it was decided to perform creep tests on entire tube sections, pressurized by inert gas. An analysis of creep rupture data allowed the determination of the parameters of the relation $\sigma = A \log t + B$ and the calculation of a mean value for the stress, causing rupture by creep after a certain time. A statistical analysis allowed the introduction of the rupture probability concept and the extrapolation of the results over an order of magnitude on the time scale. The thickness of the pressure tube was determined by reducing the rupture probability within acceptable limits, taking into account also the limitations due to neutron absorption. (auth)

26766 PRESTRESSED CONCRETE PRESSURE VESSELS FOR WATER REACTORS. Menon, S. K. (Aktiebolaget Atomenergi, Stockholm). pp 1329-36 of Pressure Vessel Technology. Pt. II. New York; American Society of Mechanical Engineers (1969).

From 1st International Conference on Pressure Vessel Technology, Delft, Netherlands. See CONF-690906(Pt.2).

Preliminary studies in Sweden showed that prestressed concrete pressure vessels (PCPV) for water reactors would also have the advantages in economy and safety that have brought about the universal adoption of such vessels for gas-cooled reactors. Development of the existing technology of PCPVs has resulted in the design for a removable top closure, a thermal insulation system suitable for water reactors, and improved calculation programs for thick-walled pressure vessels. The four Scandinavian countries are currently engaged in a joint project to build and to test a model of a water reactor PCPV. (auth)

26767 DESIGN CRITERIA FOR PRESTRESSED CONCRETE NUCLEAR REACTOR VESSELS. Rockenhauser, W.; Esztergar, E. P.; Northup, T. E. (Gulf General Atomic Inc., San Diego, Calif.). pp 1359-76 of Pressure Vessel Technology. Pt. II. New York; American Society of Mechanical Engineers (1969).

From 1st International Conference on Pressure Vessel Technology, Delft, Netherlands. See CONF-690906(Pt.2).

Prestressed concrete reactor vessel (PCRV) design adheres to the classic principles of prestressing; but because of the nature of a nuclear reactor and the complexity of vessel geometry, PCRV designs must be governed by more detailed requirements than are customarily used in the design of conventional prestressed structures. With the lack of formal design rules, criteria similar to pressure vessel codes have been developed to define the minimum requirements for design, analysis, construction, quality assurance, and inspection of PCRV's. The background of these criteria with emphasis on the structural behavior of PCRV's and an explanation of design allowables and rules are presented. Comparisons are made with steel vessels and the stress-state, failure-mode, and cyclic-strain (fatigue) characteristics of PCRV's are discussed. Design procedures and analytical methods are described and are related to the working stress and ultimate limit-load design concepts. Allowable stresses and lower-bound strength values are discussed. It is shown that elastic response to normal operating loads can be assured by specifying working-stress allowables (just as in steel pressure-vessel design). It is also shown that a margin of safety against gross distortion or failure can be obtained by specifying lower-bound limit loads that are related to the minimum strength and strain properties of the concrete and steel components. 30 references. (auth)

26768 STRUCTURAL ANALYSIS OF PRESTRESSED CONCRETE REACTOR VESSELS: STATE-OF-THE-ART. Rashid, Y. R. (Gulf General Atomic Inc., San Diego Calif.). pp 1377-85 of Pressure Vessel Technology. Pt. II. New York; American Society of Mechanical Engineers (1969).

From 1st International Conference on Pressure Vessel Technology, Delft, Netherlands. See CONF-690906(Pt.2).

A brief survey of the state-of-the-art of structural-analysis methods of prestressed concrete pressure vessels is presented. Examples are given to illustrate the degree of progress made in this area. Critical evaluations of present methods and available material data are given, and needs for future work are discussed. 12 references. (auth)

Fuels

Refer also to abstract 25196.

26769 (EURFNR-721) EXPERIMENTAL STUDIES ON PRESSURE DROP AND LONG-TIME BEHAVIOR OF SUPPORT POINTS IN A MODEL FUEL ELEMENT OF INCOLOGY 800 TUBES WITH SIX INTEGRAL HELICAL RIBS AS SPACERS IN AN ISOTHERMAL SUPERHEATED STEAM FLOW. Hoffmann, H.; Hofmann, G.; Leistikow, S. (Kernforschungszentrum, Karlsruhe (West Germany)). Translation of report KFK-1028. 67p. Dep. CFSTI.

Work Performed under United States-Euratom Fast Reactor Exchange Program.

As fuel elements for fast breeder reactors, Incoloy-800 tubes with spirals serving as cooling fins and spacers are presently under consideration. To study the behavior of such elements under simulated operating conditions a model with 37 fuel element bundles was constructed and was tested up to 500 hours with isothermal steam of 505°C, 130 atm pressure, and Reynold numbers ranging from 65,000 to 220,000. After conclusion of the test, the elements were studied as to metal loss through oxidation and deformation of the cooling fins. It was concluded that the spiral arrangement is suitable for steam-cooled reactors. (H.B.G.)

26770 (GA-8660) A COMPILATION OF TECHNICAL EVALUATIONS RELATED TO ON-LINE REFUELING SYSTEMS CONSIDERED AS ALTERNATIVES TO STUDY "A." (Gulf General Atomic, Inc., San Diego, Calif.). 30 Jun 1968. Contract AT(04-3)-167. 30p. Dep. CFSTI.

Refueling systems for HTGR development are described. Studies related to Case 2 and Case 3 systems are presented. Case 2 consists of on-line refueling of current core design with in-vessel fuel handling equipment. Case 3 involves on-line refueling of a new core design directed to simplify on-line refueling. (3 references) (D.C.C.)

26771 (GA-9896) PLANNED THERMAL IRRADIATION OF MANIFOLDED-VENTED $(U,Pu)O_2$-FUELED ROD IN ORR CAPSULE P-9. Lindgren, J. R.; Burnette, R. D.; Campana, R. J.; Baldwin, N. L.; Langer, S.; Longest, A. W. (Gulf General Atomic, Inc., San Diego, Calif.). 15 Mar 1970. Contract AT(04-3)-167. 109p. Dep. CFSTI.

The experimental design status and recommended test procedures for the thermal irradiation of Capsule P-9 in the Oak Ridge Research Reactor (ORR) are described. The purpose of the test is to study the performance and the adequacy of the manifolded fuel rod (vented to an external plenum) and its fission-product trap under conditions that are prototypical of early cores in the Gas-Cooled Fast Breeder Reactor (GCFR) demonstration plant. Test conditions include operation of the fuel rod (GA-20) for a long irradiation period to achieve a burnup >50,000 MWd/Te (15×10^{20} fissions/cm^3) at a linear heat-generation rate of 16 kW/ft and a maximum cladding outer surface temperature of 700°C and operation of the fission-product trap with its outer surface at approximately 300°C. The $(U,Pu)O_2$ fuel is of the sol-gel blended type to provide homogeneity of the Pu distribution. Fission products effusing from the trap and fuel rod during steady-state operation and during breathing will be monitored to determine the performance of the fuel and the fission-product trap. Pressure cycling and thermal cycling of varying degrees of severity will be performed. (50 references)

26772 (KFK-1082) METHOD FOR THE EXPERIMENTAL INVESTIGATION OF THE VIBRATION STATES OF FUEL RODS INDUCED BY COOLANT FLOW. Kadlec, J.; Appelt, K. D. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Nov 1969. 57p. (In German). Dep. CFSTI (U. S. Sales Only).

Experimental investigation of hydrodynamically induced lateral vibrations of pins of fuel subassembly with many spacer grids is presented. The proposed investigation method is based on the determination of the spectral density function of the bending strain at one location of the pin, which is used as a basis for calculation of spectral density functions of the displacement or of the bending stress at other locations of the pin. The proposed procedure was used for the investigation of parallel flow-induced-vibration of pin of the subassembly model of the Na 1 fast breeder reactor study. The experimental setup and the digital data acquisition system are described. The RMS-values as well as the spectral density functions of the lateral vibration of the fuel pin and of the whole subassembly, as well as of the boundary layer pressure fluctuations at the subassembly wall, are presented. (13 references) (auth)

26773 (KFK-1154) FUEL ROD BUNDLES WITH VARIOUS SPACER DESIGNS FOR SODIUM COOLED FAST REACTORS. Baumann, W.; Hoffmann, H.; Moeller, R. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorbauelemente). Mar 1970. 25p. (SM-130/38). Dep. CFSTI (U. S. Sales Only).

The pressure drop in a Na-cooled multirod fuel element and the temperature profile across its outlet section are calculated as a function of different rod arrays for grid- and helical-type spacers. These considerations are based on experimental pressure drop and coolant cross-mixing investigations. (12 references) (auth)

26774 (ORNL-4356) EXPERIMENTAL STUDIES OF THE HEAT TRANSFER AND FLUID DYNAMIC CHARACTERISTICS OF ROD-CLUSTER-TYPE NUCLEAR REACTOR FUEL ELEMENTS. Hoffman, H. W.; Kidd, G. J. Jr.; Lynch, F. E.; Stelzman, W. J.; Wantland, J. L.; Sogin, H. H. (Oak Ridge National Lab., Tenn.). May 1970. Contract W-7405-eng-26. 443p. Dep. CFSTI.

An extensive experimental study of the thermal-hydraulic characteristics of multirod gas-cooled reactor fuel elements is described. The primary emphasis was on seven-rod fuel-element clusters of the type proposed for the Experimental Gas Cooled Reactor, although several other seven-rod cluster geometries were also examined. Topics studied include pressure drop, velocity distribution, gas mixing, heat transfer, mass transfer, correlations between heat transfer and mass transfer, rod bending, flow visualization, and flow modification. The experiments were performed with air at essentially atmospheric conditions as the working fluid. In the heat transfer tests, both direct and indirect electrical heating were tried, with direct Ohmic heating being selected for the final experiments. The gas-mixing studies utilized helium as the tracer gas, and naphthalene was sublimed in the mass transfer portion of the program. Conventional static and total pressure probes were used in the pressure drop and velocity profile experiments. Flows were visualized by using cotton thread tied and/or glued to the various parts of the rod bundles. The results demonstrated that many of the average, overall thermal-hydraulic characteristics of this type of fuel element can be predicted from commonly accepted engineering correlations if appropriate corrections are made for the influence of spacers, entrance effects, etc. On the other hand, details of the turbulent flow and temperature fields are not amenable to analysis, and the effects of a phenomenon such as hot streaking must be evaluated experimentally. (auth)

26775 (ORNL-TM-2897) HEAVY ELEMENT COMPOSITION OF SPENT POWER REACTOR FUELS. Bell, M. J. (Oak Ridge National Lab., Tenn.). May 1970. Contract W-7405-eng-26. 37p. Dep. CFSTI.

Calculations were made of the heavy element composition of spent fuels for a number of reactor and fuel types. The composition, activity, and thermal power of the transuranium elements are given at time of discharge from the reactor and as a function of cooling time for times up to 10 years after discharge. Reactor and fuel types are considered which are representative of advanced light water converter reactors and first generation fast breeder reactors. (auth)

26776 (RT/FI-(69)49) POWER DISTRIBUTIONS AND REACTIVITY WORTHS CALCULATED FOR DIFFERENT PATTERNS IN A UO_2-PuO_2 MICROLATTICE. Orestano, F.; Pistella, F. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 28 Oct 1969. 71p. Dep. CFSTI (U. S. Sales Only).

Calculations performed for different patterns of a UO_2-PuO_2 microlattice irradiated in the RITMO reactor are presented. The patterns were designed to investigate the effects due to the water gaps and control rods present in power reactors. The calculated space distributions of power and spectral indexes are compared with the values measured by gamma-scanning the pins or by activating detector foils within the pins. In addition fine distributions within the fuel cell are presented. The ^{239}Pu absorption rate has also been evaluated by applying a correlation method to suitable spectral indexes. (17 references) (auth)

26777 (WCAP-3385-22) SAXTON PLUTONIUM PROGRAM. Semiannual Progress Report for the Period Ending December 31, 1969. Smalley, W. R. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). Mar 1970. Contract AT(30-1)-3385. 55p. Dep. CFSTI.

NEUTRONS—effects on Zircaloy-4 hydrogen content, γ activity, and mechanical properties, in-pile, (E)
PLUTONIUM—utilization in pressurized water reactor fuels, (E/T)
PLUTONIUM OXIDES (PuO_2)—PuO_2-UO_2, radiation effects on burnup, microstructure, and mechanical properties of pressurized water reactor fuels of, in-pile, (E)
REACTOR FUEL ELEMENTS—performance of Zircaloy-4 clad plutonium oxide (PuO_2)-uranium oxide (UO_2), in pressurized water reactors, (E/T)
REACTORS, PRESSURIZED WATER—fuels for, utilization of plutonium in, (E/T)
—fuel elements for, performance of Zircaloy-4 clad plutonium oxide (PuO_2)-uranium oxide (UO_2), (E/T)
SAXTON POWER REACTOR—fuel elements for, in-pile performance of Zircaloy clad plutonium oxide (PuO_2)-uranium oxide (UO_2), (E/T)
—fuel element cladding for, fast neutron flux exposure of Core II, (E)
—operation of, Core III zero power physics testing during
URANIUM OXIDES (UO_2)—PuO_2-UO_2, radiation effects on burnup, microstructure, and mechanical properties of pressurized water reactor fuels of, in-pile, (E)
ZIRCALOY-4—corrosion film formation on pressurized water reactor fuel element cladding of, (E)
—radiation effects on γ activity, hydrogen content, and mechanical properties of, in-pile, (E) (H.D.R.)

26778 NUCLEAR REACTOR FUEL ELEMENTS. Martin, Frederick Samuel (to United Kingdom Atomic Energy Authority). British Patent 1,186,004. 2 Apr 1970. Filed 5 Sep 1966.

Where steam is used as reactor coolant with uranium metal fuel even a small breach of the sheathing material leads to rapid oxidation of the fuel with consequent swelling, whereby a severe breach of the sheath occurs, resulting in a large discharge of fission products into the coolant stream. Double containment for a fuel element may be provided (inner and outer sheaths) with an indicating layer of suitable substance between the sheaths so that in the event of the outer sheath being breached attack by coolant on the indicating substance, with consequent emission of detectable products into the coolant stream, gives a warning allowing the defective fuel element to be exchanged before breaching of the inner sheath occurs. The uranium alloy which is employed as second substance may be a U-Mo alloy or a U-Zr alloy, and the first substance may be unalloyed uranium or U-Fe alloy or U-Fe-Al alloy. The inner and outer containments may be of Zr. The first and second substances may take the form of a duplex disk located between inner and outer containment and closures. (UK)

26779 IMPROVEMENTS IN OR RELATING TO FAST NUCLEAR REACTORS. Gratton, Charles Peter; Stamford, Stanley; Terry, James Bernard; May, William Charles (to United Kingdom Atomic Energy Authority). British Patent 1,186,862. 8 Apr 1970. Filed 29 Apr 1966.

Reference is made to the reactivity control of fast reactors which is conventionally effected by gradual withdrawl of center absorbers to compensate burnup losses. In the system described the initial fuel inventory is arranged in at least two spaced fissile zones separated by a fertile fuel zone. The fissile zones are spaced to permit neutronic coupling. The reactor is operated in such a way as to cause increased coupling between the fissile zones as burnup proceeds. The reactor core may be cooled by passing coolant in sequence through the first fissile zone, the intermediate fertile zone and the second fissile zone. The core may comprise a vertical cylinder comprising fuel elements located parallel to its axis the upper and lower sections of these elements containing fissile material. The intermediate section comprises fertile material. The core may be loaded with a critical mass of fissile material disposed about at least one zone of fertile material occupying a position at which new fissile material is created by capture to compensate for burn-up, eventually forming with the residual fissile fuel one critical mass. The core may also comprise a number of clusters of axially arranged fuel pins supported in spaced relationship so that primary coolant can flow axially through a cluster from end to end with each of the clusters comprising a central page pipe connectable to a supply of auxiliary coolant. The fuel pins are divided into a number of groups supported around the pipe within an enclosing shroud, the groups being spaced apart axially to form plenum chambers for auxiliary coolant sprayed from holes in the adjacent part of the pipe. Some of the fuel pins of each group may contain fissile material and the others fissile material. (UK)

26780 IMPROVEMENTS IN AND RELATING TO NUCLEAR REACTOR FUEL ELEMENT ASSEMBLIES. Pettinger, Donald Stanley; Yellowlees, John Mackinlay (to Nuclear Power Group Ltd.). British Patent 1,186,629. 2 Apr 1970. Filed 27 Oct 1967.

Reference is made to fuel element assemblies for high temperature gas cooled graphite moderated reactors which comprise a number of graphite sleeves arranged end to end and spigotted together to form a substantially continuous tube. The tube is capable of some degree of articulation at the joints between the sleeves. The graphite tube contains clusters of fuel-containing tubes. In the fuel element assembly described vibration is eliminated or reduced to a negligible amount without resort to clamping. The assembly comprises a number of sleeves arranged end to end, the sleeves housing fuel-containing members arranged in two or more axially spaced clusters. The fuel-containing members of a cluster are supported when the assembly is located in a vertical channel in a reactor core by the members of the cluster immediately below the fuel-containing members of each cluster. Each cluster is arranged in one or more groups associated with the fuel-containing members of the corresponding group of the cluster below. (UK)

26781 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR FUEL ELEMENTS. McCrerie, Alan Ian; Lee, Frank Leslie (to United Kingdom Atomic Energy Authority). British Patent 1,186,162. 2 Apr 1970. Filed 26 Apr 1966.

Reference is made to fuel elements of the kind comprising a cluster of fuel rods, a support grid carrying the fuel rods, and at least one spacer grid for the fuel rods, the cluster being located within a sleeve of structural moderating material, such as graphite. The fuel element described comprises a cluster of fuel rods, a support grid carrying the fuel rods, and at least one spacer grid for the fuel rods. The cluster of fuel rods is located within a sleeve of structural moderating material, and the support and spacer grids are secured to the sleeve by an annular peripheral framework which fits in an annular recess in the interior wall of the sleeve. Releasable locking means are provided which retain the annular framework of the grid in the annular recess, whereby longitudinal movement of the grid in the sleeve is prevented. (UK)

26782 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR FUEL ELEMENTS. Burton, William Robert; Ellington, John Peter (to United Kingdom Atomic Energy Authority). British Patent 1,187,929. 15 Apr 1970. Filed 6 May 1968.

Reference is made to fuel elements of the cluster type intended for fast breeder reactor operation at temperatures of at least 700°C. With ceramic fuels swelling occurs and is one of the most serious limiting factors in the achievement of high burnup, owing to the risk of metal sheath failure. The alloys currently favored as sheathing materials have a temperature limitation of 700 to 800°C, and for this reason a thermal barrier is provided between sheath and fuel for the dual purpose of operating the fuel as hot as possible and protecting the sheath metal against too high a temperature gradient across its wall thickness. For the fuel element described a philosophy different from the thermal barrier is adopted in order to provide an expected significant increase in burnup. An interlayer in which natural or depleted U metal predominates is provided between the fuel and sheathing of the fuel pin. This interlayer may be in intimate contact with the sheath, or may be bonded thereto by a good heat-conducting material, and where necessary a compatibility barrier may be provided between the interlayer and sheath. The interface between the interlayer and fuel may include grooves or depressions in order to provide voidage. (UK)

26783 SPACER FOR THE FUEL RODS OF A CLUSTER-TYPE FUEL ELEMENT OF A NUCLEAR REACTOR. Zettervall, Leif Rudolf (to Aktiebolaget Atomenergi). British Patent 1,190,046. 29 Apr 1970. Priority date 15 Aug 1966, Sweden.

REACTOR FUEL ELEMENTS—spacers for cluster arranged water cooled, description of leaf spring retained annular
REACTORS, WATER-COOLED—fuel elements of, description of leaf spring retained annular spacers for cluster arranged (D.C.C.)

26784 STUDY OF THE POSSIBILITY OF INCREASING THE POWER OF WATER-COOLED REACTORS BY INTENSIFYING THE HEAT TRANSFER BY MEANS OF ARTIFICIAL ROUGHENING. Abramidze, Sh. P.; Garsevanishvili, G. N.; Eliseev, L. A.; Kiknadze, G. I.; Litvinov, B. I. At. Energ. (USSR); 27: 547-9(Dec 1969). (In Russian).

The rate of heat transfer increases with increasing Prandtl number. It has also been found that the heat transfer is a maximum when the ratio of the distance between points of roughness S to their height h is equal to 12 to 14, that is, S/h = 12 to 14. Fuel elements were treated to create elements of roughness having a step of 4.0 mm and a height of 0.3 mm (S/h = 13). Tests showed that the increase in pressure losses of the roughened tubes was less than 44% as compared to the smooth fuel elements. Roughened and smooth fuel elements were equipped with thermocouples in order to determine local temperatures. The local temperature drops of the two types of fuel elements differed by a factor of 2.6, which also represents the ratio of the local heat transfer coefficients if we take into account the conditions for carrying out the experiments. It was found that the heat transfer data could be represented by an equation relating the Nusseldt number to the Reynolds number, the Prandtl number and the value of S/h. On the basis of these results all the smooth fuel elements in a reactor of the Georgian Republic were replaced with roughened fuel elements. On increasing the normal reactor power of 3,200 kilowatts to 7,500 kilowatts for a short period of time, it was found that the maximum surface temperature of the roughened fuel elements did not exceed 70°C at a flow rate of 33 m^3/hr while the average temperature was 33.3°C. It can be assumed that these results will be of interest not only for research reactors but also for nuclear power reactors. (TTT)

26785 NUCLEAR REACTOR FUEL BUNDLE. Lass, James Lloyd; Venier, Dominic Ambrose (to General Electric Co.). British Patent 1,190,409. 6 May 1970. Priority date 23 Sep 1966, United States.

REACTOR FUEL ELEMENTS—design parameters of water cooled cluster arranged pin type uranium oxide (UO$_2$)
REACTORS, BOILING—fuel elements for, description of cluster arranged pin type uranium oxide (UO$_2$) (D.C.C.)

26786 FUEL SUBASSEMBLY FOR A LIQUID-METAL-COOLED FAST REACTOR. Flowers, C. D.; Jakub, Marlyn T. (to U. S. Atomic Energy Commission). U. S. Patent 3,505,170. 7 Apr 1970. Filed 10 Apr 1968.

A fuel subassembly for a liquid metal-cooled nuclear reactor operating predominantly on fast neutrons includes a plurality of fuel pins disposed within a shroud. Each of the fuel pins includes an active zone and fission-gas plenum with the active zones of all fuel pins being disposed side by side while some of the fission-gas plenums are disposed upstream of the active zones, and the remainder are disposed downstream of the active zones. (AEC)

Safety and Siting

26787 (BNWL-456) CONTAINMENT SYSTEMS EXPERIMENT. PART I. DESCRIPTION OF EXPERIMENTAL FACILITIES. Linderoth, C. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Mar 1970. Contract AT(45-1)-1830. 119p. Dep. CFSTI.

The physical features of the Containment Systems Experiment are described in sufficient detail to provide an insight into the capabilities of the installations for studies of credible accidents to nuclear reactor systems. (auth)

26788 (CEA-CONF-1453) RELIABILITY OF CONTROL AND SAFETY ASSEMBLIES: INCIDENCE EFFECTS ON THE AVAILABILITY OF NUCLEAR REACTORS. Furet, J.; Peirano, F.; Quenee, R. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Sep 1969. 40p. (In French). (CONF-691115-2). Dep. CFSTI (U. S. Sales Only).

From Symposium on the Performance of Nuclear Power Reactor Components, Prague, Czechoslovakia.

The development and the technology of nuclear reactors impose from the economic viewpoint the necessity of optimizing the safety equipment. The study of this optimum necessitates the application of analysis methods based on the concepts of reliability, maintenance capabilities, and availability. After a review of the present means of prevention of accidents, studies of reliability and availability of control and safety devices are described for different types of reactors. For certain of these, a comparison was made between the predictions and the results of use, in particular with respect to the generation of electronic equipment of the multiblock type. These results show the important role of reliability characteristics and the merit factor in the search for an improved availability, but it is also true that the initiative taken by the operating crews, the development of standardization, the application of construction codes and more precise test methods are indispensable. (tr-auth)

26789 (DOCKET-50231-40) SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR. Preliminary Safeguards Summary Report, Suppl. 3. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). 30 Mar 1965. 100p. Dep. CFSTI.

Additional information on design parameters of containment structures is presented. Preoperational research and test programs are reviewed. Engineered safeguards are described. (D.C.C.)

26790 (KFK-909) CRITERIA FOR ACTION LEVELS FOR INSPECTION BASED ON A GAME THEORETICAL MODEL. Hoepfinger, E. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). Dec 1969. 19p. (CONF-690826-2). Dep. CFSTI (U. S. Sales Only).

From Conference on Systems Analysis, Vienna, Austria.

A theoretical model for analyzing a safeguards system for nuclear materials management is presented. The model is based on flow measurements of fissile material. The optimum behavior of the facility's profit-maximizing operator and safeguards authority is defined and determined. (D.C.C.)

26791 (KFK-1032) BEHAVIOR OF UO_2 AEROSOLS IN CLOSED SYSTEMS. Schikarski, W.; Wild, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). Dec 1969. 67p. (In German). (EUR-4306). Dep. CFSTI (U. S. Sales Only).

The behavior of aerosols which can be formed during large accidents of fast nuclear reactors is investigated. The program is aimed at the development and at experimental verification of the aerosol model which describes activity release via the transport characteristics of nuclear aerosols. The behavior of UO_2 aerosols in an inert atmosphere is analyzed. The UO_2 aerosols were created by the exploding wire technique in two different stainless steel vessels of 2.2 m^3 and 0.02 m^3 volume. The decrease of the particle number concentration and of the mass concentration with time was measured for various time intervals up to one week. The measured initial particle number concentrations of about 10^7 particles/cm^3 decreased several decades whereas the measured initial mass concentration decreased one decade during the experiments. The shape of the time functions of particle number concentrations allows separation into three ranges. The primary range can be attributed to the coagulation process, the final range can be attributed to the sedimentation process. An analytical expression was developed which gives, by means of an empirical term, good agreement between experiment and theory. This correlation gives the possibility, in the range of experimental errors and with the condition that extrapolation to larger volumes is allowed, of estimating the decrease of aerosol concentrations in nuclear reactor buildings as function of time. 10 references. (auth)

26792 (KFK-1153) USE OF NEUTRON-ABSORBING ADDITIONS TO THE COOLANT FOR SHUTDOWN OF FAST SODIUM-COOLED REACTORS. Schroeter, K. E.; Maubach, K.; Dorner, S. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). Feb 1970. 28p. (SM-130/37). Dep. CFSTI (U. S. Sales Only).

An independent shutdown system for Na cooled reactors is discussed. The principle of operation consists in poisoning the coolant with metals soluble in Na, i.e., miscible metals. Of all the materials considered Li with higher ^{6}Li concentrations is most suitable. The miscibility of Li with Na is safeguarded for the conditions of concentration if the temperature does not fall below 150°C. After the coolant has been poisoned, Li can be separated from Na by simple methods. The corrosion problems which may arise play no major part. Calculations show that already small concentrations of ^{6}Li in the coolant of a breeder reactor give rise to considerable shutdown reactivities. For the Na-cooled 300 MW(e) reactor Na2, a technical concept is indicated by means of which the primary cycle can be poisoned in emergencies. The main principle consists in an automatic self-dosage of the poisoning by a Venturi nozzle. Quick-acting Li injectors bridge the startup phase of the automatic poisoning system. 41 references. (auth)

26793 (ORNL-NSIC-73) INDEX TO NUCLEAR SAFETY. A TECHNICAL PROGRESS REVIEW BY CHRONOLOGY, PERMUTED TITLE, AND AUTHOR. Vol. 1, No. 1 through Vol. 10, No. 6. Blakely, J. P.; Klein, Ann (Oak Ridge National Lab., Tenn.). Apr 1970. Contract W-7405-eng-26. 104p. Dep. CFSTI.

A bibliography of Nuclear Safety articles is presented. The bibliography is separated into three sections: chronological list of articles; permuted title index; and author index. (D.C.C.)

26794 (SZS-15/69) EVALUATION OF THE VOLATILE RADIOACTIVE RELEASES FROM NUCLEAR INSTALLATIONS FOR VARIOUS OPERATING CONDITIONS. Schimmel, W. (Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany)). Dec 1969. 17p. (In German). Dep. CFSTI (U. S. Sales Only).

The volatile radioactive releases from nuclear installations are analyzed. The fundamental way of accident analysis is outlined for an incident caused by a large loss of coolant. The consequences for the installation as well as the environment are shown. (7 references) (auth)

26795 DESIGN OF CONDENSER COOLING WATER SYSTEM FOR A NUCLEAR POWER PLANT LOCATED ON A LARGE ESTUARY. Jeffers, F. J. (Baltimore Gas and Electric Co.); Geyer, J. C.; Neale, L. C. J. Eng. Power; 92: 150-6(Apr 1970).

From 90th Annual Meeting on American Society of Mechanical Engineers, Los Angeles, Calif.

A coordinated program is described for developing information needed for designing a condenser cooling water system for a nuclear power plant located on a large estuary to meet State water quality standards and minimize any adverse effects on aquatic life. Estuarine conditions pertinent to the design of the intake and discharge structures, the heat assimilative capacity of the estuary, application of the momentum jet theory to the condenser cooling water discharges, and hydraulic model investigations to determine mixing and dispersion patterns are discussed. (8 references) (auth)

26796 SIMULATION EXPERIMENT OF THE RESULTS OF FISSION PRODUCT GAS RELEASE DUE TO FUEL CLADDING FAILURE USING WATER CIRCULATION SYSTEM. Kondo, Shunsuke; Miyaguchi, Kimihide; An, Shigehiro; Oyama, Akira. J. Nucl. Sci. Technol. (Tokyo); 7: 197-209(Apr 1970).

To examine the effects of fission product gas release into the coolant channel due to fuel cladding failure, two preliminary simulation experiments were undertaken using an electrical heater pin set in a system for water circulation. The first experiment represented a continuous release of gas from a small hole in the cladding, and the second a sudden burst of gas into the system due to plenum rupture. The first experiment revealed that the cladding surface temperature registered a sharp dip at the stagnation point of the water flow created immediately upstream of the gas releasing hole and that the temperature at the bottom of the dip was very sensitive to the ratio between the gas release rate and water flow rate. In the second experiment, representing plenum rupture, a pressure pulse of about 8 kg/cm^2 was registered on the wrapper tube, and the cladding surface temperature was found to rise by about 10°C within 0.1 sec (with heating at 100 W/cm), due to gas blanketing. The magnitude of the deformation and the transient strain on the cladding surface were also measured. (auth)

Research and Test Reactors

Refer also to abstracts 25170, 26771, 26834, and 26835.

26797 (BNWL-500(Vol.31)) CONCEPTUAL SYSTEM DESIGN DESCRIPTION FOR THE REACTOR CORE SYSTEM, NO. 31. Fast Flux Test Facility. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). 27 Aug 1969. Contract AT(45-1)-1830. 155p. Dep. CFSTI.

Conceptual design calculations and parameters are presented for FTR core components. Core structures, control elements, control element drives, fuel elements, and instrumentation systems are described. 21 references. (D.C.C.)

26798 (BNWL-500(Vol.61)) CONCEPTUAL SYSTEM DESIGN DESCRIPTION FOR THE CLOSED LOOP SYSTEM, NO. 61. Fast Flux Test Facility. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). 22 Nov 1968. Contract AT(45-1)-1830. 220p. Dep. CFSTI.

Conceptual design calculations and parameters are presented for FTR liquid Na cooled in-pile loop. 54 references. (D.C.C.)

26799 (BNWL-500(Vol.82)) CONCEPTUAL SYSTEM DESIGN DESCRIPTION FOR THE INERT GAS RECEIVING AND PROCESSING SYSTEM, NO. 82. Fast Flux Test Facility. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). 4 Dec 1968. Contract AT(45-1)-1830. 201p. Dep. CFSTI.

Conceptual design calculations and parameters are presented for FFTF inert cover gas system. 77 references. (D.C.C.)

26800 (BNWL-554) TECHNICAL BASES FOR THE FFTF MAIN HEAT TRANSPORT SYSTEM CONCEPT AND CONCEPT CONFIGURATION SELECTIONS. Harvey, R. A.; Johnson, H. G.; McLaughlin, M. A.; Witeck, E. F. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Sep 1967. Contract AT(45-1)-1830. 169p. Dep. CFSTI.

Studies were made to evaluate the main heat transport system concept and concept configuration for the FFTF. Systems with air and steam/water heat dumps are considered, and configurations with two through seven parallel cooling circuits are considered for each concept. Comparisons are made considering design bases, capital investment, operating cost, steady-state process performance and system reliability and availability. All systems are rated at 400 MW(+). The recommended concept is a system with an air heat dump. Installation of a redundant cooling circuit is recommended for all normal operational phases. The recommended number of installed parallel cooling circuits is four or five depending on the need for a sustained 1200°F core coolant bulk outlet temperature capability at 400 MW(+). Four circuits are recommended if the 1200°F capability is not a routine requirement, but five are recommended if there is a routine need for the 1200°F capability. (auth)

26801 (BNWL-970) FFTF MODIFIED FERMI CONTROL ROD DRIVE MECHANISM CONCEPTUAL DESIGN STUDY. McBride, J. R.; Fryer, B. C. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Jun 1969. Contract AT(45-1)-1830. 116p. Dep. CFSTI.

Conceptual design calculations and parameters are presented for FTR control rod drives. The drives are based on the Fermi Fast Breeder Reactor safety rod concept. 16 references. (D.C.C.)

26802 (BNWL-1319) DYNAMIC DIGITAL COMPUTER SIMULATION OF THE FFTF DUMP HEAT EXCHANGER. Madsen, R. N. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr 1970. Contract AT(45-1)-1830. 70p. Dep. CFSTI.

The complex problem of analytically modeling the FFTF extended-surface Na-to-air dump heat exchanger (DHX) for dynamic simulation is investigated in detail. The development of an extremely detailed reference model followed by the determination of an idealized yet adequate simple model is described. In connection with this study, a detailed investigation of transient fin efficiency for fins of constant thickness is reported. 14 references. (auth)

26803 (BNWL-1328) FAST FLUX TEST FACILITY. Quarterly Technical Report, December 1969–February 1970. Wolfe, B. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr 1970. Contract AT(45-1)-1830. 175p. Dep. CFSTI.

BORON CARBIDES—compatibility with Type 316 stainless steel, measurement of high temperature
FAST FLUX TEST FACILITY—design and development during December 1969 to February 1970
FAST TEST REACTOR—design and development during December 1969 to February 1970
—fuel duct welding for
—heat exchanger for, dynamic digital computer simulation of dump
—cooling system of, computer simulation for
—control system of, development of instrumentation for
—core for, design specifications of conceptual
—in-pile loops for, development and testing of
—loading machine for, development of
—fuels for, irradiation testing of
—fuel element cladding for, development of stainless steel
—fuel cycle technology for
—fuel elements of, fabrication techniques for pin type
—core physics for, (E/T)
—control elements of, reactivity worth measurements for, (E/T)
—shielding for, performance of Type 304 and Type 316 stainless steel
—safety analysis for
GAMMA RADIATION—shielding of, performance of Type 304 and Type 316 stainless steel
NEUTRONS—shielding of, performance of Type 304 and Type 316 stainless steel
NEUTRONS, FAST—effects on mechanical properties of Type 316 stainless steel
STAINLESS STEEL—shielding properties of Type 304 and Type 316, calculations for gamma radiation and neutron
—compatibility with boron carbide (B_4C) of Type 316, measurement of high temperature
—radiation effects on mechanical properties of Type 316, fast neutron (D.C.C.)

26804 (BNWL-1333) FFTF SHIELDING PROGRAM. Bunch, W. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr 1970. Contract AT(45-1)-1830. 44p. Dep. CFSTI.

The development program required to support the design of nuclear radiation shields throughout the Fast Flux Test Facility (FFTF) is described. The development plan is based on providing adequate and timely design information for the unique features of the facility. Remaining development work is indicated for penetrations and for special Na-steel shield geometries. In addition to experimental work, analytical techniques and nuclear data need to be refined and developed for use with the materials of interest in the design of liquid-metal cooled, fast-reactor shields. 33 references. (auth)

26805 (BNWL-1335) MODIFIED FERMI CONTROL ROD LATCH FOR THE FFTF: REPORT ON THE DEVELOPMENT AND TESTING PROGRAM. McBride, J. R. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr 1970. Contract AT(45-1)-1830. 61p. Dep. CFSTI.

A development and testing program was conducted on an electromagnet and latch assembly for the Modified Fermi Control Rod Drive Mechanism Concept proposed for the Fast Flux Test Reactor (FTR). The components tested were designed to the FTR conceptual requirements. The electromagnet was successfully tested in ambient air to determine the load carrying capability (1000 lb) and release characteristics. The latch assembly was successfully tested in water for 5000 latch and scram cycles with a simulated load of 2400 lb. 5 references. (auth)

26806 (DOCKET-50128-20) TEXAS A AND M RESEARCH REACTOR. Nuclear Science Center Progress Report No. 6, December 31, 1968–December 31, 1969. (Texas Engineering Experiment Station, College Station). Feb 1970. Contract AT(20-2)-852. 82p. (ORO-852-3). Dep. CFSTI.

26807 (DOCKET-50231-39) SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR. Preliminary Safeguards Summary Report, Suppl. 1. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). 23 Feb 1965. 294p. Dep. CFSTI.

Additional information on Southwest Experimental Fast Oxide Reactor is presented under the following broad topics: Plant Site and Environment; Containment; Reactor Design; Plant Design; Waste Disposal; Control and Safety Instrumentation; and Safety Analysis and Dose Calculations. Appendices contain information on design requirements for containment structures and pressure vessel. (D.C.C.)

26808 (KURRI-TR-60) MEASUREMENTS OF NEUTRON FLUX AND SPECTRUM AT KUR IRRADIATION FACILITIES. Kanda, Keiji; Nanjyo, Tsutomu; Kobayashi, Katsuhei; Nakagome, Yoshihiro; Kozuka, Toshihiko; Tsukaguchi, Kenichi; Kimura, Itsuro; Shibata, Toshikazu (Kyoto Univ. (Japan). Research Reactor Inst.). 1969. 25p. (In Japanese). Dep. CFSTI (U. S. Sales Only).

The neutron flux and spectrum at the KUR irradiation facilities were measured by foil activation techniques. By using various kinds of foils, neutron fluxes in the thermal, epithermal, and fast energy regions were absolutely measured. The deviations from the reference neutron spectrum in each energy region were also obtained. The spectral parameters and each flux are tabulated. (auth)

26809 (NP-tr-1886) THE RISE OF ACTIVE WATER FLOW IN THE OSIRIS REACTOR POOL. Lerouge, B.; Huffenus, J. P.; Lambert, P. Translated by A. Marty (Australian Atomic Energy Commission), from Houille Blanche; 23: 711-24(1968). 26p. Dep. CFSTI (U. S. Sales Only).

The Osiris swimming pool type reactor has been in operation at the Nuclear Research Center at Saclay since 1966. General problems encountered in designing the circulation system for this type of reactor are discussed. The hydraulic research and tests which confirmed the validity of the proposed scheme are described. Due to the site background, the only reasonable way to achieve the desired 50 MW rated output was by designing for rising flow in the core, which also meant taking steps to counter the following possible undesirable effects: excessive pool temperature increase due to large-scale heat exchange between the hot core outflow and the colder water in the pool; and unacceptable activity on the pool surface, which would impair ease of operation enabling convenient direct access to the core, which is one of the main advantages of this kind of reactor. The proposed design reduces the upflow of warm water from the core in the pool to a minimum with the least possible adverse effect on flexible reactor operation. (BBB)

26810 (ORNL-TM-2853) A PROCEDURE FOR PREDICTING THE EFFECTS OF LOSS-OF-COOLANT ACCIDENTS IN THE ORNL TOWER SHIELDING REACTOR II. Kidd, G. J. Jr. (Oak Ridge National Lab., Tenn.). May 1970. Contract W-7405-eng-26. 25p. Dep. CFSTI.

An analytical study has been made of the temperature distribution in the Tower Shielding Reactor II at Oak Ridge National Laboratory following a complete and instantaneous loss of coolant water. The temperature structure is examined in detail for several different operating schemes. The results of this analysis are then generalized to produce a workable set of administrative procedures which will guarantee safe operation. 4 references. (auth)

26811 THE DESIGN AND MECHANICAL PERFORMANCE CHARACTERISTICS OF THE ZERO POWER PLUTONIUM REACTOR. McCarthy, P. B.; Lawroski, Harry (Argonne National

Lab., Idaho Falls, Idaho). J. Eng. Power; 92: 166-72(Apr 1970). (CONF-691114-4).

From 90th Annual Meeting on American Society of Mechanical Engineers, Los Angeles, Calif.

The Zero Power Plutonium Reactor (ZPPR) is a fast experimental reactor that operates at very low power levels and is used to simulate proposed fast power plutonium reactors in the 1000-MW range. The reactor is built on two large tables, one stationary and one movable, with numerous roller bearings on the underside for ease of travel. Half of the reactor is built on each table, and then the tables are brought together before the reactor can go critical. The tables are each designed to support at least 120 tons of fuel and structural material. Load tests were conducted to prove the system and to determine deflections in the foundation and runways. Many safety devices are built into the table drive system, such as an electric feed-rail system that disconnects the power supply to the drive motor if a relay fails, three speeds of table closing to control reactivity-addition rates, and two independent table-separation systems. Fuel control rods are used for reactivity changes; fuel and poison safety rods are used for shutdown control. Core material is loaded into 2 × 2 × 23-in. drawers, and the drawers are slid into matrix tubes stacked 10 feet high on the tables. Matrix tubes and drawers and the tables were aligned to obtain a minimum gap at the interface. (auth)

26812 TEST OF THE COMPONENTS FOR FBR MECHANISM WITH A Na LOOP. Fujita, Mototsugu; Suzuki, Yasuyuki (Fuji Electric Co., Tokyo). FAPIG (Tokyo); No. 52, 236-7(Feb 1969). (In Japanese).

In Japan, the design of an experimental Na-cooled fast breeder reactor is being carried out. A Na experiment facility was installed, and the sealing device and the latch mechanism, mainly used for the driving mechanism for control rods and the fuel replacing equipment, were tested for their operation in liquid Na of 300–600°C. The Na circulating circuit consists of two test vessels, regenerative heat exchanger, electro-magnetic pump, preheater, heater and electromagnetic flow meter. The sodium refining circuit consists of cold trap, plugging indicator and electro-magnetic flow meter. The main material employed is stainless steel of JIS SUS 32 (AISI 316). The particulars of the installation are as follows: the temperature of test vessels is 600°C max.; the controlled temperature range is room temperature–600°C; the amount of Na circulation is 0.36 m^3/hr and max. is 1.5 m^3/hr; the amount of Na is 300 kg; heater capacity is 100 kW; the detection limit of the O_2 concentration in Na is 10 ppM; cover gas is highly pure Ar at a rate of 0–45 liter/min; and pressure of 0–3 kg/cm^2 g. (NSA of Japan)

26813 RESEARCH REACTORS AND NUCLEAR EXPERIMENTAL EQUIPMENT. London; British Nuclear Forum (Sep 1969). 60p.

An illustrated description is given of some of the UK research reactor facilities and their capabilities under the following headings: Research reactors and their uses; "Helen," "Dimple," "Herald," "Dido," "Hector," "Vera," pulsed neutron sources; "Viper"; "Consort II"; neutron physics experiments; irradiation experiments (nonfissile irradiations; fissile irradiations; design of experiments; control and instrumentation; neutron converters; loop experiments; safety; irradiation rigs for overseas reactors); nucleonic instrumentation for research reactors (zero energy reactors; materials testing research reactors); fuel for research reactors; post-irradiation equipment; disposal of radioactive waste; siting and safety; out-of-pile experimental equipment; and company profiles. (UK)

26814 A SIGNALLING SYSTEM FOR PNEUMATIC TUBE DISPATCH INSTALLATIONS IN NUCLEAR REACTORS. (to Kernforschungsanlage Julich GmbH). British Patent 1,189,630. 29 Apr 1970. Priority date 9 Mar 1968, Germany.

REACTOR EXPERIMENTAL FACILITIES—rabbit system of, description of acoustic transducers and photoelectric position indicator for pneumatic (D.C.C.)

26815 REGULATING THE ENERGY OF A FAST PULSE REACTOR BY MEANS OF AN INJECTOR. Popov, A. K. At. Energ. (USSR); 27: 554-6(Dec 1969). (In Russian).

Only the average power can be regulated in a fast pulse reactor having a rotating fuel element or reflector. With fluctuations in the reactivity there will take place fluctuations in the energy which is emitted in each power pulse. The energy of this pulse can be regulated by using an electron accelerator whose pulse is introduced to the reactor at a corresponding moment of time. It is assumed that the injector generates stable pulses of electrons having the same frequency as the power pulses. It is shown that the energy of the power pulse strongly depends on the moment of injection of the electrons, that is, on the reactivity of the system at the moment of injection and subsequently. An equation is given to describe the behavior of the reactor power after injection of the electron which reacts with a target in the reactor to give secondary neutrons in the reactor. It is found that the difference in energies which are released in power pulses with and without the external source can differ by a factor of 3. Since the reactor is unstable because it is below criticality for a certain period of time, it becomes possible to regulate the power reactor with a low-power injector. (TTT)

26816 NEUTRON DENSITY MICRODISTRIBUTION IN THE WWR-SM UNIT CELL. Jozefowicz, Edward Tadeusz (Inst. of Nuclear Research, Swierk, Poland); Turi, Laszlo; Valko, Janos. Nukleonika; 14: 1171-7(1969).

The neutron density microdistribution measurements were performed in a light-water moderated cell with multitube enriched fuel (WWR-SM type). The sector foil method was used and a method of drilling the fuel and filling the hole with materials simulating successive cell layers and with detecting foils was applied. The results are compared with the theoretical ones obtained using the THERMOS code. (10 references) (auth)

26817 THE RESULTS OF EXPERIMENTS FOR INSTALLATION OF A LARGE DIAMETER CENTRAL CHANNEL IN THE VVR-K REACTOR CORE. Batyrbekov, G. A.; Okolovic, V. N.; Takibaev, Zh. S. Vestn. Akad. Nauk Kaz. SSR; No. 8, 10-14 (Aug 1969). (In Russian).

The possibility of installing a large diameter channel in the VVR-K reactor core was investigated. Included in the analysis were: the critical core loading; the control rod efficiencies and the effects of varying their position in the core; and the thermal neutron distribution in 90 and 140 mm channels. The results of the analysis indicate a channel of up to 140 mm can be installed. (tr-auth)

Rocket and Space Reactors

26818 (N-70-16678) PRELIMINARY ANALYSIS OF ACCIDENTS IN A LITHIUM-COOLED SPACE NUCLEAR POWER PLANT. Davidson, Harry W. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Jan 1970. 25p. (NASA-TM-X-1937; E-5123). CFSTI.

Reactor power, fuel, and coolant temperature responses to five types of accidents (loss of coolant, loss of flow, ramp reactivity insertions, cold Li additions, and plugging of coolant channel) occurring at 100% power were calculated to establish preliminary safety requirements for a UN-fueled fast reactor. Loss of coolant must be avoided, or auxiliary coolant must be provided within 380 sec to avoid melting the fuel. After losing coolant flow, natural convective cooling is inadequate, and auxiliary pumps may have to provide up to 20% of the design flow to prevent coolant boiling. (auth) (STAR)

Process Heat and Desalination Reactors

Refer also to abstract 25037.

26819 IMPROVEMENTS IN OR RELATING TO WATER BORNE DESALINATION APPARATUS. Johnson, Keith David Bebb (to United Kingdom Atomic Energy Authority). British Patent 1,186,187. 2 Apr 1970. Filed 24 May 1966.

Reference is made to a nuclear-powered ship equipped with multi-stage flash distillation desalination plant, for supplying desalinated water to suitably located reservoirs. The ship preferably takes the form of a tanker with a desalination plant associated with the hull propulsion unit so that the major portion of the power output of the propulsion unit is supplied to the desalination plant. A suitable vessel may comprise a tanker hull having large capacity water storage tanks of approximately 65,000 tons dead weight, with a desalination plant of 4×10^6 gallons/day output, and a 15 MW(e) or 60 MW(t) nuclear propulsion unit to supply power for the desalination plant, pumping and propulsion. The vessel could operate at slow cruising speeds. The water output may be temporarily stored in large or flexible container type vessels associated with the plant vessel. (UK)

26820 SWEET WATER FROM NUCLEAR ENERGY. Bainbridge, G. R. Tech. Eau (Brussels); No. 265, 29-35(Jan 1969). (In French).

Desalination by distillation can produce water of good quality for industry (less than 25 ppm of dissolved solids) and it is the most commonly used process. Work carried out in Great Britain on the flash process is described from the point of view of economic advantage in dual-purpose nuclear plant (gas or vapor-cooled heavy water reactors). The process is described and illustrated with diagrams, photographs, and flow sheets. Depending on the size of project with the price of electricity at 6 cents per KWh, the price of water per m^3 varies from 4 to 9 cents. (auth)

Marine and Portable Power Reactors

Refer also to abstract 26819.

26821 (AD-700135) MH-1A STEADY STATE AND TRANSIENT THERMAL-HYDRAULIC DESIGN ANALYSIS. Safety Analysis Report. Myers, Charles A.; Meyer, Charles E.; Stollmeyer, Michael A. (Army Engineer Reactors Group, Fort Belvoir, Va. Engineering Div.). 25 Jul 1969. 175p. (ED-6916). CFSTI.

A brief description of the MH-1A floating nuclear power plant is given followed by the safety system set points and operating limits of the reactor. The design bases, from which the limits were developed, are given. A parametric analysis is made of the thermal-hydraulic capabilities of the MH-1A Type I core during steady-state operation. This includes calculation of peak centerline fuel temperatures at various powers, the maximum linear heat rate, DNBR, and maximum hot channel enthalpy rise. Also included are analyses of transient conditions accompanying such accidents as power range rod withdrawal and main steam pipe rupture. (auth) (USGRDR)

26822 (AD-701906) MH-1A REFUELING, OCTOBER 17-25, 1969. Final Report. Sears, C. Frederick (Army Engineer Reactors Group, Fort Belvoir, Va. Engineering Div.). 20 Dec 1969. 39p. (ED-6923). CFSTI.

The initial refueling of the MH-1A (STURGIS) took place in October 1969. The nuclear behavior of the reactor during refueling is described. Various figures and tables are used to illustrate the measured nuclear behavior. (auth) (USGRDR)

26823 (DOCKET-50238-59) N. S. SAVANNAH. Operating License NS-1. Technical Specifications Change No. 23. (First Atomic Ship Transport, Inc., New York). 6 May 1970. 5p. Dep. CFSTI.

Drydocking procedures are described. Decay heat removal systems and electrical power systems for drydock conditions are revised. (D.C.C.)

Reactor Theory

26824 LOCAL BURNUP DISTRIBUTION FOR OPTIMIZATION OF THE TOTAL IN-PILE BURNUP AT FIXED POWER. Bartosek, Vaclav (Inst. of Nuclear Research, Rez, Czech.). Jad. Energ.; 16: 121-4(1970).

The problem of how to distribute the local burnup in a slab light water reactor core so that the total in-pile burnup would be at its maximum value is investigated. Conditions placed on the analysis are that the total power is fixed and the neutron flux and specific power values are not at their maximum. (H.D.R.)

Kinetics

26825 (GA-9950) NEUTRON SCATTERING KERNELS CALCULATIONS AT EPITHERMAL ENERGIES. Borgonovi, G. M. (Gulf General Atomic, Inc., San Diego, Calif.). 17 Mar 1970. Contract AT(04-3)-167. 24p. Dep. CFSTI.

For some reactor spectra calculations, neutron scattering kernels extending up to epithermal energies of 3 to 5 eV are needed. The FLANGE and FLANGE-II codes were modified to compute an approximate value of the scattering law for energy transfers larger than the maximum in the tabulated scattering law for thermal energies. The basic steps in the derivation of the short collision time approximation formula used in modifying the codes are summarized, and the differences between the FLANGE and FLANGE-II codes are described. Examples of results obtained with the codes are given, and the performance of the two codes is compared. (7 references) (H.D.R.)

26826 (LA-4267) CONSTRAINED OPTIMAL PROGRAMMING PROBLEMS IN REACTOR STATICS. Axford, Roy Arthur (Los Alamos Scientific Lab., N. Mex.). Aug 1969. Contract W-7405-eng-36. 30p. Dep. CFSTI.

Optimal fuel concentration distributions, which maximize the power rating of a reactor assembly, are determined for various sets of inequality constraints. These include constraints on the upper and lower limits of the allowable fuel concentration, the upper limit of the power density, and the upper limit of the fast flux level and the level of the sum of the fast and thermal fluxes. (13 references) (auth)

26827 (ORNL-TM-2950) SPACE- AND FREQUENCY-DEPENDENT ENERGY SPECTRUM OF NEUTRON WAVES IN A MODERATING MEDIUM. Booth, R. S.; Swansiger, W. A. (Oak Ridge National Lab., Tenn.). 22 Apr 1970. 27p. Dep. CFSTI.

A theoretical investigation was made of the effect of continuum energy-mode contamination on thermal-neutron wave experiments conducted with graphite. The incentive for this work was that the cooling coefficient obtained experimentally is larger by a factor of two than that predicted by theory. The eigenfunction expansion method of analysis with use of the sophisticated scattering kernel SUMMIT resulted in a reconstruction of the energy spectrum of the neutron waves, with both frequency and distance from the source as parameters. This reconstructed flux was used to calculate the fraction of an experimental measurement that would be caused by the continuum energy-modes. It is concluded that continuum energy-mode contamination would introduce an error of <5% in the experiment mentioned above, and, thus, it could not account for the factor of 2 discrepancy between the theoretical and experimental results. (11 references) (auth)

26828 (ORNL-tr-2036) STUDY OF THE ALBEDO PROBLEM FOR THE NEUTRON TRANSPORT IN A PLATE. Kiesewetter, H.; Kruse, R. Translated for Oak Ridge National Lab., Tenn., from Kernenergie; 11: 3-10(Jan 1968). 15p. Dep. CFSTI.

In contrast to previous studies of the albedo problem, the application of the Fourier-transformation method results in an improved representation of the total flux $\phi(x)$. During the numerical evaluation of the results over a large range of parameters, the separation of the solution into an asymptotic component $\phi_{as}(x)$ and a component from transport theory $\phi_{tr}(x)$ is investigated. For particles incident under an oblique angle it is shown that $\phi_{as}(x) < \phi(x)$, and $\phi_{as}(x) > \phi(x)$ for vertically incident particles. (4 references) (auth)

26829 (RPI-328-188) ANOMALY IN THE USE OF THE SECOND-ORDER FORM OF THE DISCONTINUOUS VARIATIONAL METHOD. Becker, Martin (Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Nuclear Science). 30 Apr 1970. Contract AT(30-1)-328. 5p. Dep. CFSTI.

It is shown that, for a general class of reactor physics problem, the use of the second order form of the discontinuous variational method does not yield a nontrivial solution. Use of the second order form on the functional for a Sturm-Liouville equation is observed to not provide a useful algorithm for generating approximate solutions. (H.D.R.)

26830 AN INTRODUCTION TO THE NEUTRON KINETICS OF NUCLEAR POWER REACTORS. Tyror, J. G.; Vaughan, R. I. The Commonwealth and International Library. Oxford; Pergamon Press Ltd. (1970). 188p. $6.25.

Topics discussed included: the neutron physics of reactor kinetics; feedback effects; water-moderated reactors; fast reactors; methods of control; reactor transients following faults; and the use of computers. (D.C.C.)

26831 METHOD FOR COLLAPSING FAST-REACTOR NEUTRON CROSS SECTIONS. Pavelescu, M.; Anton, V.; Purica, I. (Inst. of Atomic Physics, Bucharest). Nucl. Sci. Eng.; 39: 407-9(Mar 1970).

26832 APPROXIMATING THE MULTIGROUP EQUATIONS OF NEUTRON KINETICS. Brikker, I. N.; Mirzoyan, A. R. At. Energ. (USSR); 27: 556-8(Dec 1969). (In Russian).

On excluding the concentration of delayed neutron predecessors, a multigroup equation of neutron kinetics is given in integral-differential form. This equation contains a kernel of an integral which carries all information that the effect of delayed neutrons will have on the kinetics of neutron diffusion. It follows that solution of the problem reduces to setting up criteria which give minimum distortion of the kernel of the integral. A minimum in the average square deviation is taken in selecting the parameters of one or two equivalent neutron groups. An estimate of the approximation error is carried out that depends not only on the accuracy of approximating the kernel, but also on how fast the neutron density is being varied. This method is the most accurate of the two-group methods given in the literature. The single-group model with optimal values of the equivalent parameters gives significantly less error than a number of non-optimal, two-group models, and is comparable in accuracy with all two-group, non-optimal models reported in the literature. (TTT)

Experimental Applications

Refer also to abstracts 26742, 26743, 26816, and 26837.

26833 (RT/FI-(69)18) THE DI.R.A.C. CODE. Bitelli, G.; Salvatores, M.; Dal Bono, I.; Leproni, V. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 21 Mar 1969. 15p. Dep. CFSTI (U. S. Sales Only).

The DIRAC computer program for evaluating real and adjoint flux distributions is presented. The computer program is written in FORTRAN 4 for the IBM 7094/7040. (2 references) (D.C.C.)

26834 ANALYSIS OF HETEROGENEITY EFFECT BY MONTE CARLO METHOD. Nomoto, Shoji; Nakamura, Hisashi. J. Nucl. Sci. Technol. (Tokyo); 7: 212-15(Apr 1970).

In a cell at the center of FCA III-1, the correction factor is mainly determined by the source heterogeneity because the spectrum is hard. Estimation of the heterogeneity effect on the core diffusion coefficient for an entire core requires careful treatment, because it involves anisotropy of diffusion within the cell, and strongly affects the neutron leakage from the core boundary. In the Monte Carlo calculations, the coefficient D can be derived directly from the mean free path l in a cell, and therefore the value of D can be expected to be improved. (auth)

Reactor Components, Fuels, and Accessories

Refer also to abstracts 25094, 25169, 25173, 25177, 25179, 25187, 25189, 25197, 25236–25238, 25243, 25244, 25319, 25334, 25340, 25631, 25632, 25650–25652, 25661, 25713, 25714, 25749, 25761–25764, 25767, 25769–25771, 25803, and 25804.

26835 (BNWL-1358) PLUTONIUM UTILIZATION PROGRAM. Technical Activities Quarterly Report, December 1969–February 1970. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr 1970. Contract AT(45-1)-1830. 170p. Dep. CFSTI.

- FISSION PRODUCTS—release of gaseous, from irradiated mixed oxide fuels, (E)
- NEUTRONS—effects on plutonium oxide (PuO_2)–uranium oxide (UO_2) microstructure, in-pile, (E)
- PLUTONIUM OXIDES PuO_2—PuO_2–UO_2, radiation effects on microstructure of vibrationally compacted, in-pile, (E)
- PLUTONIUM RECYCLE TEST REACTOR—fuel elements for, irradiation performance of mixed oxide, (E)
- REACTOR FUEL ELEMENTS—dose rates from boiling water type mixed oxide rod arrays containing high exposure recycle plutonium, (E)
  - —fuel centerline temperatures in, effects of mixed oxide fuel type and pellet designs on, (T)
  - —radiation effects on Zircaloy clad plutonium oxide (PuO_2)–uranium oxide (UO_2), defect test assembly for
  - —radiation effects on dimensional changes in Zircaloy clad mixed oxide, effects of fuel compaction process on, (E)
  - —fission gas analysis from high power density mixed oxide, (E)
  - —cladding failure in high burnup mixed oxide, effects of fuel contaminates on Zircaloy, (E)
- REACTOR SAFETY—transient behavior of Zircaloy clad plutonium oxide (PuO_2)–uranium oxide (UO_2) fuel elements, (E)
- REACTORS, BOILING—fuel rod arrays for, dose rates from high exposure plutonium containing, (E)
- URANIUM OXIDES UO_2—PuO_2–UO_2, radiation effects on microstructure of vibrationally compacted, in-pile, (E)
- ZIRCALOY—corrosion of fuel cladding of, effects of fuel contaminates on localized, (E) (H.D.R.)

26836 (CEA-Bib-177) USE OF TRACERS IN DEVICES FOR LOCATING LEAKS IN FUEL ELEMENT CANS. Donguy, Rene (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Apr 1970. 29p. (In French). Dep. CFSTI (U. S. Sales Only).

The literature survey, presented chronologically, covers the period from January 1961 to June 1969. At this date, the most frequently used tracers were xenons and ^{198}Au used in conjunction with ^{122}Sb. (auth) (France)

26837 (LIB/Trans-246) THEORETICAL ANALYSIS OF FUEL ROD VIBRATION INDUCED BY PARALLEL COOLANT FLOW. Namatame, K. Translated by P. L. Nicol (Australian Atomic Energy Commission), from Nippon Genshiryoku Gakkaishi; 11: 398-405(1969). 13p. Dep. CFSTI (U. S. Sales Only).

A theoretical analysis was made of fuel rod vibration in a nuclear reactor coolant channel with water flowing parallel to the rod axis. The analysis was based on the fact that the force inducing the fuel rod vibration is the pressure fluctuation of water flowing in the channel, and that this pressure fluctuation travels along the channel with a speed proportional to the mean water velocity. Using the result of the present analysis, a comparison was made with previous experimental results. It was found that the present analysis could very well explain the observed behavior of rod vibration, and that it could further serve in deducing other characteristics so far remaining unclarified. (17 references) (auth)

26838 (TID-25394) LATERAL STRUCTURE: FOUNDATION INTERACTION OF NUCLEAR POWER PLANTS WITH LARGE BASE MASSES. Technical Report No. 3. Scavuzzo, R. J.; Raftopoulos, D. D.; Bailey, J. L. (Toledo Univ., Ohio. Research Foundation). Sep 1969. Contract AT(40-1)-3822. 104p. Dep. CFSTI.

The extent to which the inertia of a large reactor structure will interact with the free-field seismic ground forces to alter the base motion of the structure from that of the free-field and hence to alter the structural forces caused by the base motion is analyzed. An analysis is made of the lateral motion of the foundation of an N-mass structure with a large base mass coupled to a two-dimensional elastic half-space the free-field motion of which simulates that of an earthquake. The acceleration spectra for the free-field motion and the resulting foundation motion derived provide the basis for comparing the forces each of the two motions excites within the structure. The analysis defers all consideration of rocking and vertical effects for later study. Numerical results for two free-field acceleration inputs are computed for physically significant values of the parameters defining structure and ground properties. Some idealized one and two-mass structures and a three-mass two-mode model of a nuclear power plant are subjected to these inputs. The extent of the interaction is shown to be strongly dependent upon the ground stiffness and the frequency relationship between the seismic motion and the structure. Results indicate that interaction effects are sufficiently important to warrant consideration in the seismic design of nuclear power plants. (11 references) (auth)

26839 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR FUEL ELEMENTS. Cookson, William Francis; Cocker, Peter (to United Kingdom Atomic Energy Authority). British Patent 1,186,346. 2 Apr 1970. Filed 27 Apr 1966.

Reference is made to fuel elements of the cluster type with the fuel rods supported in parallel spaced relationship. The fuel rods can either be supported with their weight taken by a bottom support grid and having a top spacer grid and one or more intermediate spacer grids for maintaining correct lattice position and spacing, or be suspended from a top support grid and provided with bottom and one or more intermediate spacer grids. In both cases it is necessary to secure the appropriate end of each fuel rod to either the bottom or top support grid in such a way that the fuel rods are retained in correct axial position to the support grid. The mode of securing, however, must be such that the fuel rods can be readily removed from the support grid after irradiation. In the system described the rods are releasably secured to the support grid by deformation of a part of the grid into engagement with an end portion of each fuel rod, whereby the rods are restrained against axial movement relative to the grid. Various constructional embodiments of the invention are described. The weight of the fuel rod may be transferred to the support grid by engagement not involving deformation of the grid. (UK)

26840 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR FUEL ELEMENTS. D'Eye, Royston Walter Mastin; Shennan, John Vincent; Ford, Lionel Houston (to United Kingdom Atomic Energy Authority). British Patent 1,185,637. 25 Mar 1970. Filed 22 Jun 1966.

Reference is made to the production of fuel elements suitable for operation at high temperatures and which are able to retain solid and gaseous fission products. In the fuel element described the fuel particles in the ceramic container are bonded together by bridges of bonding material of high thermal conductivity. The bridges may be of metallic construction and the metal employed may be reactive with the particle coating material to form a bond of ceramic material between the particles in addition to the metal bridge. The fuel particles may consist of pyrolytic carbon coated UC, with Si bridges and Si C bonds formed by reaction between the

Si and the pyrolytic carbon coating. Methods for producing such fuel elements are described. The ceramic container may also be of Si C. (UK)

26841 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR FUEL ELEMENT ASSEMBLIES. Chetter, John; Jones, Cecil Henry (to United Kingdom Atomic Energy Authority). British Patent 1,186,518. 2 Apr 1970. Filed 21 Jul 1966.

Reference is made to fuel element assemblies which contain a number of fuel pins supported in a bundle with their longitudinal axes parallel, and which employ one or more spacer grids located intermediately which serve to retain the correct location of the fuel pins in the assembly. The fuel assembly described has at least one spacer grid comprising a structure of cellular form, the cells being penetrated by fuel pins, and the grid structure deferring at least two spaced stop means for each fuel pin. Two of these stops are spaced in a plane transverse to the longitudinal axis of the fuel pin. Resilient means are provided to hold each fuel pin against the spaced stop means. The resilient means for holding each fuel pin is positioned at the apex of an isosceles triangle relative to the spaced stop means which are positioned at the basal corners of the isosceles triangle. In one form of spacer grid the grid structure is formed from a series of parallel strips of material to define cells of rectangular form which are penetrated by the fuel pins, resilient means being carried by at least one wall of each of the rectangular cells of the grid structure. Each resilient means holds an associated fuel pin against stop means defined by the two walls of the rectangular cell adjacent to the wall of the cell carrying the resilient means. Several alternative designs of spacer grid are also described. (UK)

26842 CALCULATION OF THE PROBABILITY OF FAULTS IN A RELAY EVALUATION CIRCUIT. Schruefer, Elmar (AEG-Telefunken, Frankfurt am Main). At. Strom; 16: 29-32(Feb 1970). (In German).

For an evaluation circuit constructed of relays the following probabilities are calculated: for a harmless relay fault; for a dangerous relay fault; for incorrect tripping of the system; and for a dangerous failure of the system. 5 references. (auth)

26843 SUPPORT FOR A NUCLEAR FUEL ELEMENT. Aubert, Michel; Lebey, Jacques; Sejourne, Serge (to Commissariat a l'Energie Atomique). British Patent 1,190,189. 29 Apr 1970. Priority date 23 Apr 1968, France.

REACTOR FUEL ELEMENTS—support for graphite sleeve annular, description of cylinder centered metal tie rod (D.C.C.)

26844 SUPPORT FOR A NUCLEAR FUEL ELEMENT. Aubert, Michel; Lebey, Jacques; Sejourne, Serge (to Commissariat a l'Energie Atomique). British Patent 1,190,188. 29 Apr 1970. Priority date 23 Apr 1968, France.

REACTOR FUEL ELEMENTS—support for graphite sleeve annular, description of cylinder centered stirrup shaped metal (D.C.C.)

26845 THREE-DIMENSIONAL STRESS ANALYSIS OF A CONCRETE REACTOR VESSEL. Tucakov, Joza. Nukl. Energ.; 5: No. 6, 30-7(1968-9). (In Serbo-Croatian).

A review is presented of a method called "dynamic relaxation" which enables a numerical analysis of the stress in thick-walled vessels. A description of the method for the analysis of the reactor vessel stress and strain distortion is included. The thermal stress in the concrete reactor vessel due to varying distribution and changes in the temperature over the vessel walls is analyzed. (6 references) (auth)

26846 CONTROL AND SAFETY DEVICE FOR NUCLEAR REACTORS. Fenech, Henri; Farmer, Richard A. U. S. Patent 3,507,748. 21 Apr 1970. Filed 7 Jun 1967.

A device is described which ensures the shutdown of nuclear reactors by introduction of neutron absorbing materials in the reactor core or blanket and reflector. The shutdown can be caused by an excess of power production over and above the system's ability to remove this power. The motion in the device is caused by an increase in the vapor pressure of an intermediate fluid interposed in the heat flow path between the nuclear fuel and the coolant. This increased pressure causes a net force in the poisoning slug with a resultant deplacement. The device can be shaped and sized according to the need and the reactor geometry. It is self-actuated and inherently safe. (AEC)

26847 PRESSURE BALANCED FUEL BUNDLE INLET. Germer, John H. (to U. S. Atomic Energy Commission). U. S. Patent 3,501,377. 17 Mar 1970. Filed 10 Feb 1969

A nuclear reactor fuel bundle inlet is described which provides means for preventing lifting forces due to hydrostatic pressure differential at the entrance to the fuel bundle, while permitting radial misalignment and means for monitoring coolant flow to the individual fuel bundles. This is accomplished by utilizing seals of approximately equal areas, where the seals are exposed to the pressure differential in opposing directions, thus the pressure forces are essentially balanced. In addition, a rocking motion is provided to allow for misalignment. (AEC)

26848 PRESSURE VESSEL TECHNOLOGY. PART I. DESIGN AND ANALYSIS. First International Conference, Delft, Netherlands, September 29–October 2, 1969. New York; American Society of Mechanical Engineers (1969). 673p. $37.50. (CONF-690906-(Pt.1)).

Fifty-one papers given during the international symposium on design and analysis methods used in pressure vessel technology held at Delft, Netherlands, Sept. 29 to Oct. 2, 1969, are presented. Separate abstracts were prepared for 8. The remaining 43 papers contain information not within the scope of NSA. (L.C.L.)

For abstracts of individual papers see: 25172–25175, 25712, 26695, 26793, and 26764.

26849 PRESSURE VESSEL TECHNOLOGY. PART II. MATERIALS AND FABRICATION. First International Conference, Delft, Netherlands, September 29–October 2, 1969. New York; American Society of Mechanical Engineers (1969). 727p. $37.50. (CONF-690906-(Pt.2)).

Fifty-seven papers given during the symposium on materials and fabrication methods used in pressure vessel technology held at Delft, Netherlands, Sept. 29 to Oct. 2, 1969, are presented. Separate abstracts were prepared for 26. The remaining 31 papers contain information not within the scope of NSA. (L.C.L.)

For abstracts of individual papers see: 25176–25179, 25235–25243, 25661, 25713, 25714, 25815, 26696–26700, and 26765–26768.

26850 HEAT EXCHANGE APPARATUS FOR EXTRACTING HEAT FROM A NUCLEAR FUEL HEAT PRODUCER. Strohmeyer, Charles Jr. (to Electrodyne Research Corp.). U. S. Patent 3,507,747. 21 Apr 1970. Filed 14 Jul 1967.

The invention provides an apparatus for circulating coolant fluid flow through a nuclear reactor wherein there are multiple conduit assemblies each having a high temperature coolant fluid circuit flowing around a portion of the nuclear fuel elements and a lower temperature coolant fluid circuit encompassing the high temperature circuit within the conduit assembly outer wall. The outer wall provides structural containment of the internal fluids. The high temperature circuits have recirculation and pumping means and means to exchange heat with the fluid effluent from the lower temperature coolant fluid circuit before delivery of the effluent to a steam consumer. (AEC)

26851 IMPROVEMENTS IN OR RELATING TO CORE ELEMENT HANDLING SYSTEMS FOR NUCLEAR REACTORS. (to Gulf General Atomic Inc.). British Patent 1,190,603. 6 May 1970. Priority date 27 Sep 1966, United States.

REACTOR LOADING MACHINES—design parameters of pneumatic actuated telescoping tubes with pivoting grapple head (D.C.C.)

26852 IRRADIATION CELL FOR USE IN SODIUM-COOLED REACTOR. (to Commissariat a l'Energie Atomiqe). British Patent 1,186,846. 8 Apr 1970. Priority date 19 Jan 1968, France.

A design is given of an irradiation cell for the irradiation of samples in a liquid sodium-cooled reactor. The liquid-sodium reactor coolant is employed directly for filling the irradiation cell around the sample while a gaseous expansion volume is maintained above the sodium. (J.C.W.

GENERAL

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